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ESSAYS,

POLITICAL, ECONOMICAL,

AND

PHILOSOPHICAL.

Thompson

By BENJAMIN, COUNT OF RUMFORD,
KNIGHT OF THE ORDERS OF THE WHITE EAGLE, AND ST. STANISLAUS;
Chamberlain, Privy Counſellor of State, and Lieutenant-General in the Service of his Moſt Serene Highneſs the ELECTOR PALATINE *Reigning* DUKE *of* BAVARIA; *Colonel of his Regiment of Artillery, and Commander in Chief of the General Staff of his Army*; F. R. S. Acad. R. Hiber. Berol. Elec. Boicœ. Palat. et Amer. Soc.

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ADVERTISEMENT.

ALMOST four years have elapſed ſince this Eſſay was announced to the Public, and although a conſiderable part of the Manuſcript was then ready, yet, from a variety of conſiderations, I have been induced to defer ſending it to the preſs; and even new the Firſt Part only of the Eſſay is laid before the Public.

Among the motives which have operated moſt powerfully to induce me to poſtpone the publication of this work was a deſire to make it as free of faults as poſſible, and to accommodate it as much as poſſible to the actual ſtate of opinions and practices in this country.

In proportion as my exertions to promote uſeful improvements have been favourably received by the Public, and my writings have obtained an extenſive circulation, my anxiety has been increaſed to deſerve that confidence which is eſſential to my ſucceſs. I feel it to be more and more my duty to proceed ſlowly, and to uſe every precaution in inveſtigating the ſubjects I have undertaken to treat, and in explaining what I recommend, in order that others may not be led into errors, either by miſtakes in principle, or inaccuracy in deſcription.

I have, indeed, of late ſeen but too many proofs of the neceſſity of adopting this cautious method of proceeding.

On my return to England from Bavaria laſt autum (1798), after an abſence of two years, I was not a little gratified to learn, that ſeveral improvements recommended in my Eſſays, and particularly the alterations in the conſtruction of Chimney Fire-places, that were propoſed in my Fourth Eſſay, had been adopted in many places; and that they had in general been found to anſwer very well; but the ſatisfaction which this information naturally afforded me, has ſince been,—I believe I may ſay,—more than counterbalanced by the pain I have experienced on diſcovering, on a nearer examination, the numerous miſtakes that have been committed by thoſe who have undertaken to put my plans in execution:—not to mention the unjuſtifiable uſe that has in ſome inſtances been made of my name, in bringing forward for ſale inventions which I never recommended, and of which I never can approve without abandoning all the fundamental principles relative to the combuſtion of fuel, and the management and direction of heat, which, after a long and patient inveſtigation, I have been induced to adopt.

It would be fooliſh for me to imagine, and ridiculous to pretend, that the plans I have propoſed are ſo perfect as to be incapable of farther improvement. I am far, very far, from being of that opinion, and I can ſay with truth, that I ſhall at all times rejoice when farther improvements are made in them; but ſtill I may be permitted to add, that it would be a great ſatisfaction to me if thoſe, who, from an opinion of their utility, or from a deſire to give the experiment a fair trial, ſhould be diſpoſed to adopt any of the plans I have recommended, would take the trouble to examine whether the workmen they employ really underſtand, and are diſpoſed to follow the directions I have given,—or whether they are not, perhaps, prepoſſeſſed with ſome favourite contrivance and imaginary improvement of their own,—or whether there is no danger of their introducing alterations for the purpoſe of enhancing the price of their work,—or of the articles they furniſh.

Theſe are dangers of which thoſe who have the ſmalleſt acquaintance with mankind, muſt be perfectly ſenſible; and it would be unwiſe, and I had almoſt ſaid unjuſt, not to attend to them, at leaſt to a certain degree.

All I aſk is, that a *fair trial* may be given to the plans I propoſe, when *any* trial is given them; and this requeſt will not, I truſt, be thought unreaſonable: and as I never preſume to recommend to the Public any new invention or improvement that I have not previouſly and repeatedly tried, and found *by experience* to be uſeful, it would perhaps be thought excuſeable were I to expreſs a wiſh that my propoſals might not be condemned nor neglected merely in conſequence of the failure of contrivances announced as *improvements* of my Plans.

The reader will not be ſurprized at my extreme anxiety to remove thoſe obſtacles which appear to me moſt powerfully to obſtruct and retard the general introduction of the improvements I am labouring to introduce; for anxiety for the ſucceſs of an undertaking naturally flows from a conviction of its importance, and is always connected with that fervent zeal which important undertakings are ſo eminently calculated to inſpire.

To this Second Edition of the Firſt Part of my Tenth Eſſay, I beg leave to add a few words reſpecting the SOUP ESTABLISHMENTS that have lately been formed in London, and in other places, for feeding the Poor.

Many perſons in this country are of opinion that a great deal of meat is neceſſary in order to make a good and wholeſome ſoup; but this is far from being the caſe in fact. Some of the moſt ſavoury and moſt nouriſhing ſoups are made without any meat; and in providing food for the poor it is neceſſary, on many accounts, to be very ſparing in the uſe of it.

When the poor are fed from a Public Kitchen, care ſhould be taken to ſupply them with the cheapeſt kinds of food, and particularly with ſuch as they can afterwards provide for themſelves, at their own dwellings, at a ſmall expence; otherwiſe the temporary relief that is afforded them in times of ſcarcity, by ſelling to them rich and expenſive meat ſoups at reduced prices, will operate as a great and a permanent evil to themſelves and to ſociety.

The moſt palatable and the moſt nouriſhing ſoups may, with a little care and ingenuity, be compoſed with very cheap materials, as has been proved of late by a great number of deciſive experiments made upon a large ſcale in different countries. The Soup Eſtabliſhments that have been formed at Hamburgh,—at Geneva,—at Lauſanne, and other parts of Switzerland,—at Marſeilles, and lately at Paris, have all ſucceeded; and at moſt of theſe places the kind of ſoup that was provided for the poor at Munich has been adopted, with but little variation.—In ſome caſes a ſmall quantity of ſalt meat has been uſed, but this has been merely as a ſeaſoning: the baſis of theſe ſoups has uniformly been barley, potatoes, and peas or beans; and a ſmall quantity of bread has in all caſes been added to the ſoup when it has been ſerved out.

No ingredient is, in my opinion, ſo indiſpenſably neceſſary in the ſoups that are furniſhed to the poor as *bread*; it ſhould never be omitted, and certainly not in times of ſcarcity; becauſe there is no way in which bread will go ſo far as when it is eaten in ſoups: for every ounce ſo uſed, I am confident that four ounces that would otherwiſe be eaten by the poor at their homes, would be ſaved. And to this we may add, that oaten cakes, and other bread of inferior quality, will anſwer very well in ſoups, particularly if it be toaſted or fried, and broken or cut into ſmall pieces. If the ſoup be well ſeaſoned, its taſte will predominate, and the taſte peculiar to the bread will not be perceived.

A great variety of the moſt agreeable taſtes may be given to ſoups, at a very ſmall expence; and if bread be mixed with the ſoup, maſtication will be rendered neceſſary, and the pleaſure that is enjoyed in eating a good meal of it will be greatly prolonged and increaſed.

It is by no means ſurprizing that prejudices ſhould be ſtrong againſt ſoups, in thoſe countries where ſoups and broths are conſidered as being merely thin waſh without taſte or ſubſtance, a pint of which might as eaſily be ſwallowed down at a breath as ſo much water; but theſe prejudices will vaniſh when the falſe impreſſions which gave riſe to them are removed.

Soups may, it is true, be made thick and ſubſtantial with meat; but when this is done, they are neither palatable nor wholeſome: they appal and load the ſtomach,—weaken the powers of digeſtion,—and inſtead of affording wholeſome nouriſhment, ſtrength, and refreſhment, are the cauſe of many diſorders; they are moreover very expenſive. But this is not the caſe with ſoups made thick and ſubſtantial with farinacious matter, and other vegetable ſubſtances, and ſeaſoned and rendered palatable with ſalt, pepper, onions, and a little ſalted herrings, hung beef, bacon, or cheeſe, and eaten with a due proportion of bread.

I am the more anxious to recal the attention of the Public to this ſubject at the preſent time, as the utility of the Public Kitchens for feeding the Poor, which have lately been formed and are now forming in various parts of the kingdom, muſt depend very much on the choice of the ingredients uſed in preparing food, and the manner of combining them, which is adopted by thoſe who have the direction of theſe intereſting eſtabliſhments. The ſhare I have had in bringing theſe eſtabliſhments into uſe,—the opinion I entertain of their importance to ſociety,—and the anxiety I muſt naturally feel for their ſucceſs,—will, I flatter myſelf, be conſidered as a ſufficient excuſe for my ſolicitude in watching over their progreſs, and for the liberty I may take in pointing out any miſtakes in the management of them that might tend to bring them into diſrepute.

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ESSAY X.

ON THE

CONSTRUCTION OF KITCHEN FIRE-PLACES

AND

KITCHEN UTENSILS,

TOGETHER WITH

REMARKS and OBSERVATIONS relating to the various *PROCESSES OF COOKERY;*

AND

PROPOSALS for improving that MOST USEFUL ART.

ESSAY X.

INTRODUCTION.

In contriving machinery for any purpoſe, it is indiſpenſably neceſſary to be acquainted with the nature of the mechanical operation to be performed; and though the Proceſſes of Cookery appear to be ſo ſimple and eaſy to be underſtood, that any attempt to explain and illuſtrate them might perhaps be thought not only ſuperfluous but even frivolous, yet when we examine the matter attentively, we ſhall find their inveſtigation to be of ſerious importance.—I ſay of *ſerious* importance, for ſurely thoſe inquiries which lead to improvements by which the providing of *food* may be facilitated, are matters of the higheſt concern to mankind, in every ſtate of ſociety.

The proceſs by which food is moſt commonly prepared for the table,—BOILING,—is ſo familiar to every one, and its effects are ſo uniform, and apparently ſo ſimple, that few, I believe, have taken the trouble to inquire *how*, or in *what manner*, thoſe effects are produced; and whether any, and what improvements in that branch of cookery are poſſible. So little has this matter been an object of inquiry, that few, very few indeed, I believe, among the *millions of perſons* who for ſo many ages have been *daily* employed in this proceſs, have ever given themſelves the trouble to beſtow one ſerious thought on the ſubject.

The cook knows *from experience*, that if his joint of meat be kept a certain time immerſed in boiling water, it will be *done*, as it is called in the language of the kitchen; but if he be aſked *what* is done to it?—or *how*, or *by what agency* the change it has undergone has been effected?—if he underſtands the queſtion,—it is ten to one but he will be embarraſſed:—if he does not underſtand it, he will probably anſwer without heſitation, that "*the meat is* "*made tender and eatable by being boiled.*"—Aſk him if the boiling of the water be eſſential to the ſucceſs of the proceſs?—He will anſwer, "*without* "*doubt.*" Puſh him a little farther by aſking him, whether, *were it poſſible* to keep the water *equally hot* without boiling, the meat would not be cooked *as ſoon*, and *as well*, as if the water were made to boil? Here it is probable that he will make the firſt ſtep towards acquiring knowledge, *by learning to doubt.*

When you have brought him to ſee the matter in its true light, and to confeſs that *in this view of it* the ſubject is new to him, you may then venture to tell him, (and to prove to him, if you happen to have a thermometer at hand,) that water which *juſt boils* is as hot as it can poſſibly be made *in an open veſſel.*—That all the fuel which is uſed in making it boil with violence is waſted, without adding a ſingle degree to the heat of the water, or expediting or ſhortening the proceſs of cooking a ſingle inſtant.—That it is by *the heat*,—its *intenſity*, and the *time of its duration*, that the food is cooked,—and not by the *boiling* or *ebullition*,—or bubbling up of the water; which has *no part whatever* in that operation.

Should any doubts ſtill remain in his mind with reſpect to the inefficacy and inutility of boiling, in culinary proceſſes, where *the ſame degree of heat* may be had, and be *kept up* without it, let a piece of meat be cooked in a Papin's digeſter, which, as is well known, is a boiler whoſe cover (which is faſtened down with ſcrews) ſhuts with ſo much nicety that no ſteam can eſcape out of it. In ſuch a *cloſed* veſſel, boiling (which is nothing elſe but the eſcape of ſteam in bubbles from the hot liquid) is abſolutely impoſſible; yet, if the heat applied to the digeſter be ſuch as would cauſe an equal quantity of water in an open veſſel to boil, the meat will not only be *done*, but it will be found to be dreſſed in a ſhorter time, and to be much tenderer than if it had been boiled in an open boiler. By applying a ſtill greater degree of heat to the digeſter, the meat may be ſo much done in a very few minutes as actually to fall to pieces; and even the very bones may be made ſoft.

Were it a queſtion of mere idle curioſity, whether it be the *boiling* of water, or ſimply the *degree of heat* which exiſts in boiling water, by which food is cooked, it would doubtleſs be folly to throw away time in its inveſtigation; but this is far from being the caſe, for *boiling* cannot be carried on without a very great expence of fuel; but any boiling-hot liquid (by uſing proper means for confining the heat) may be kept *boiling-hot* for any length of time almoſt without any expence of fuel at all.

The waſte of fuel in culinary proceſſes, which ariſes from making liquids boil *unneceſſarily*, or when nothing more would be neceſſary than to keep them *boiling-hot*, is enormous. I have not a doubt but that much more than half the fuel uſed in all the kitchens, public and private, in the whole world, is waſted preciſely in this manner.

But the evil does not ſtop here. This unſcientific and ſlovenly manner of cooking renders the proceſs much more laborious and troubleſome than otherwiſe it would be;—and, (what by many will be conſidered of more importance than either the waſte of fuel, or the increaſe of labour to the cook,)—the food is rendered leſs ſavoury, and very probably leſs nouriſhing and leſs wholeſome.

It is natural to ſuppoſe that many of the finer and more volatile parts of food (thoſe which are beſt calculated to act on the organs of taſte) muſt be carried off with the ſteam when the boiling is violent; but the fact does not reſt on theſe reaſonings;—it is *proved* to a demonſtration, not only by the agreeable fragrance of the ſteam which riſes from veſſels in which meat is boiled, but alſo from the ſtrong flavour and ſuperior quality of ſoups which are prepared by a long proceſs over a very gentle fire.

In many countries where ſoups conſtitute the principal part of the food of the inhabitants, the proceſs of cooking laſts from one meal-time to another, and is performed almoſt without either trouble or expence. As ſoon as the ſoup is ſerved up, the ingredients for the next meal are put into the pot, (which is never ſuffered to cool, and does not require ſcouring,) and this pot,—which is of caſt iron,—or of earthen ware,—being well cloſed with its thick wooden cover, is placed *by the ſide of the fire*, where its contents are kept ſimmering for many hours, but are ſeldom made to boil, and never but in the gentleſt manner poſſible.

Were the pot placed in a cloſed fire-place, (which might eaſily be conſtructed, even with the rudeſt materials, with a few bricks or ſtone, or even with ſods, like a camp-kitchen,) no arrangement for cooking could well be imagined more economical, or more convenient.

Soups prepared in this way are uncommonly ſavoury; and I am convinced that the true reaſon why nouriſhing ſoups, and broths, are not more in uſe among the common people in Great Britain and Ireland, is becauſe they do not know how good they really are, nor how to prepare them; in ſhort, becauſe they are not acquainted with them.

But to return from this digreſſion. It is moſt certain, not only that meat and vegetables of all kinds may be cooked in water which is kept *boiling-hot*, without actually boiling, but alſo that they may even be cooked with a degree of heat *below* the boiling point.

It is well known that the heat of boiling water is not the ſame in all ſituations;—that it depends on the preſſure of the atmoſphere,—and conſequently is conſiderably greater at the level of the ſurface of the ſea than inland countries, and on the tops of high mountains; but I never heard that any difficulty was found to attend the proceſs of dreſſing food by boiling, even in the higheſt ſituations. Water boils at London, (and at all other places on the ſame level,) at the temperature of 212 degrees of Fahrenheit's thermometer; but it would be abſolutely impoſſible to communicate that degree of heat to water in an open boiler in Bavaria. The boiling point at Munich under the mean preſſure of the atmoſphere at that place is about 209½ degrees of Fahrenheit's thermometer; yet nobody, I believe, ever perceived that boiled meat was *leſs thoroughly done* at Munich than at London. But if meat may, without the leaſt difficulty, be cooked with the heat of 209½ degrees of Fahrenheit at Munich, why ſhould it not be poſſible to cook it with the ſame degree of heat in London?—If this can be done, (which I think can hardly admit of a doubt,) then it is evident that the proceſs of cookery, which is called *boiling*, may be performed in water which is not boiling-hot.

I well know, from my own experience, how difficult it is to perſuade cooks of this truth, but it is ſo important, that no pains ſhould be ſpared in endeavouring to remove their prejudices and enlighten their underſtandings. This may be done moſt effectually in the caſe before us by a method I have ſeveral times put in practice with complete ſucceſs.—It is as follows:—Take two equal boilers, containing equal quantities of *boiling-hot water*, and put into them two equal pieces of meat taken from the ſame carcaſs,—two legs of mutton, for inſtance—and boil them during the ſame time. Under one of the boilers make a *ſmall fire*, juſt barely ſufficient to keep the water *boiling-hot*, or rather juſt *beginning to boil:*—under the other make *as vehement a fire as poſſible*, and keep the water boiling the whole time with the utmoſt violence.

The meat in the boiler in which the water has been kept *only juſt boiling-hot*, will be found to be quite as well done as that in the other *, under which ſo much fuel has been waſted in making the water boil violently to no uſeful purpoſe.—It will even be more done; for as a great deal of water will be boiled away, (evaporated,) during the proceſs, in the boiler under which a great fire is kept up, this boiler muſt often be filled up; and if the water with which it is from time to time repleniſhed be cold, this will of courſe retard the proceſs of cooking the meat.

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* It will even be found to be much better cooked,—that is to ſay, tenderer, more juicy, and much higher flavoured.

To form a juſt idea of the enormous waſte of fuel that ariſes from making water boil, and *evaporate* unneceſſary in culinary proceſſes, we have only to conſider how much heat is expended in the formation of ſteam. Now it has been proved by the moſt deciſive and unexceptionable experiments that have ever been made by experimental philoſophers, that if it were poſſible that the heat which actually combines with water, in forming ſteam, (and which gives it wings to fly up into the atmoſphere,)—could exiſt in the water, without changing it from a denſe liquid to a rare elaſtic vapour, this water would be heated by it to the temperature of red-hot iron.

From the ſame *data* it is eaſy to ſhew, by computation, that if any given quantity of ice-cold water can be made to boil with the heat generated in the combuſtion of a certain quantity of any given kind of fuel, it will require more than *five times* that quantity of fuel to reduce that ſame quantity of water,—already boiling-hot,—to ſteam.

Hence it appears, that in the formation of ſteam there is a great and unavoidable *expence* of heat; but it does not ſeem probable that heat is *expended* or *combined*, in any of thoſe proceſſes by which food is prepared for the table,—except it be perhaps in baking;—and as heat is *immortal*,—that is to ſay,—as it never dies, or ceaſes to exiſt; and as its diſperſion may be prevented, or at leaſt greatly *retarded*, by various ſimple contrivances, it is not ſurpriſing, when we conſider the matter attentively, that moſt of thoſe proceſſes (in which nothing more ſeems to be neceſſary than that the food to be cooked ſhould be expoſed a certain time in a medium at a certain temperature) ſhould be capable of being performed with *a very ſmall expence of fuel.*

The quantity of heat, or rather the quantity of fuel, by which any given culinary proceſs may be performed, may be determined with much certainty and preciſion from the reſults of experiments which have already been made.

Suppoſe, for inſtance, it were required to compute the quantity of dry pine-wood (what in England is called deal) uſed as fuel, and burned in a cloſed fire-place, conſtructed on the moſt approved principles, to boil 100 lbs. of beef. And firſt we will ſuppoſe this beef to be in ſuch large pieces, that 3 hours of boiling, after it has been made boiling-hot, are neceſſary to make it ſufficiently tender to be fit for the table: and we will ſuppoſe farther, that 3 lbs. of water are neceſſary to each pound of beef; and that both the water and the beef are at the temperature of 55° of Fahrenheit's thermometer (the mean temperature of the atmoſphere in England) at the beginning of the experiment.

The firſt thing to be aſcertained is how much fuel would be required to heat the water and the beef *boiling-hot*; and then to ſee how much more would be required to *keep them boiling-hot* three hours.

And firſt for *heating the water* ;—it has been ſhewn by one of my Experiments (N° 20, EſſayVI.), that $20\frac{1}{10}$ lbs. of water may be heated 180 degrees of Fahrenheit's thermometer with the heat generated in the combuſtion of 1 lb. of dry pine-wood.

But it is required to heat the water in queſtion only 157 degrees; for its temperature being that of 55°, and the boiling point 212°, it is 212°—55°=157°: and if 1 lb. of the fuel be ſufficient for heating $20\frac{1}{10}$ lbs. of water 180 degrees, it muſt be ſufficient for heating 23 lbs. of water 157 degrees —for 157° is to 180° as $20\frac{1}{10}$ lbs. to 23 lbs.

But if 23 lbs. of water, at the temperature of 55°, require 1 lb. of dry pine-wood, as fuel, to make it boil, then 300 lbs. of water (the quantity required in the proceſs in queſtion) would require $12\frac{6}{10}$ lbs. of the wood to heat it boiling-hot.

To this quantity of fuel muſt be added that which would be required to heat the meat (100 lbs. weight) boiling-hot. Now it has been found by actual experiment by the late ingenious Doctor Crawford, (ſee his Treatiſe on Animal Heat, ſecond edition, page 490,)—that the fleſh of an ox requires leſs heat to heat it than water, in the proportion of 74 to 100; conſequently the quantity of beef in queſtion (100 lbs.) might be made boiling-hot with preciſely the ſame quantity of fuel as would be required to heat 74 lbs. of water at the ſame temperature to the boiling point.—And this quantity in the caſe in queſtion would amount to to 3¼ lbs. as will be found on making the computation.

This quantity (3¼ lbs.) added to that before found, which would be required to heat the water alone, (=23 lbs.) gives 26¼ lbs. of dry pine-wood for the quantity required to heat 300 lbs. of water and 100 lbs. beef (both at the temperature of 55°) boiling-hot.

To eſtimate the quantity of fuel which would be neceſſary to keep this water and beef boiling-hot 3 hours, we may have recourſe to the reſults of my experiments. In the Experiment, N° 25, (ſee Eſſay VI.) 508 lbs. of boiling-hot water were kept actually boiling—not merely kept boiling-hot)—3 hours with the heat generated in the combuſtion of 4½ lbs. of dry pine-wood,—this gives 338⅔ lbs. of boiling-hot water kept boiling 1 hour with 1 lb. of the fuel; and computing from theſe data.—And ſuppoſing farther that a pound of beef requires as much heat to keep it boiling-hot any given time as a pound of water, it appears that 3½ lbs. of pine wood, uſed as fuel, would be ſufficient to keep the 300 lbs. of water, with the 100 lbs. of beef in it, boiling 3 hours. This quantity of fuel (=3½ lbs.), added to that required to heat the water and the meat boiling-hot (=26½ lbs.), gives 29¾ lbs. of pine wood, for the quantity of fuel required to cook 100 lbs. of boiled beef.

This quantity of fuel, which is juſt about equal in effect to 16 lbs.—or ¾ of a peck of pit-coal, will doubtleſs be thought a ſmall allowance for boiling 100 lbs. of beef; but it is in fact much more than would be neceſſary *merely for that purpoſe*, could all the heat generated in the combuſtion of the fuel be applied *immediately* to the cooking of the meat, and *to that purpoſe alone*. Much the greateſt part of that which is generated is expended in heating the water in which the meat is boiled, and as it remains in the water after the proceſs is ended it muſt be conſidered as loſt.

This loſs may, however, be prevented in a great meaſure; and when that is done, the expence of fuel in boiling meat will be reduced almoſt to nothing. We have juſt ſeen that 100 lbs. of meat, at the mean temperature of the atmoſphere in England, (55°,) may be made boiling-hot with the heat generated in the combuſtion of 3¼ lbs. of pine-wood; and there is no doubt but with the uſe of proper means for confining the heat, this meat might be kept boiling-hot 3 hours, and conſequently be thoroughly done, with the addition of ¾ of a pound of the fuel, making in all 4 lbs. of pine-wood, equal in effect to about 2¼ lbs. of pit-coal; which, according to this eſtimate, is all the fuel that would be *abſolutely neceſſary* for cooking 100 lbs. of beef.

This quantity of fuel would coſt in London leſs than *one farthing and a half*, when the chaldron of coals weighing 28 cwt. is ſold at 40 ſhillings. This, however, is the *extreme* or *utmoſt limit* of the economy of fuel, beyond which it is abſolutely impoſſible to go. It is even impoſſible in practice, to arrive at this limit, for the containing veſſel muſt be heated, and kept hot, as well as the meat;—but very conſiderable advances may be made towards it, as I ſhall ſhew hereafter.

If we ſuppoſe the meat to be boiled in the uſual manner, and that 300 lbs. of cold water are heated expreſsly for that purpoſe, in that caſe the fuel required, amounting to 16 lbs. of coal, would coſt in London—(the chaldron reckoned as above)—juſt 2 *pence* 1¼ *farthings*. But all this expence ought not to be placed to the account of the cooking of the meat; by adding a few pounds of barley-meal, ſome greens, roots, and ſeaſoning, to the water, it may be changed into a good and wholeſome ſoup, at the ſame time that the meat is boiled; and the expence for fuel (2 pence 1¼ farthings) may be divided between the meat boiled, (100 lbs.) and 300 lbs. or 37½ gallons of ſoup.

I am aware of the danger to which I expoſe myſelf by entertaining the public with accounts of facts, and of deductions from them which are certainly much too new and extraordinary to be credited, but on the ſtrongeſt proofs, while many of the arguments and computations I offer in their ſupport, however concluſive they may, and certainly *muſt*, appear to natural philoſophers and mathematicians,—are ſuch as the generality of readers will be tempted to paſs over without examination; but deeply impreſſed with the importance of the object I have in view, I am determined to purſue it at all hazards.

My principal deſign in publiſhing theſe computations is to *awaken the curioſity of my readers*, and fix their attention on a ſubject, which however low and vulgar it has hitherto generally been thought to be, is, in fact, highly intereſting, and deſerving of the moſt ſerious conſideration. I wiſh they may ſerve to inſpire cooks with a juſt idea of the importance of their art,—and of the intimate connection there is between the various proceſſes in which they are daily concerned, and many of the moſt beautiful diſcoveries that have been made by experimental philoſophers in the preſent age.

The advantage that would reſult from an application of the late brilliant diſcoveries in Philoſophical Chemiſtry, and other branches of Natural Philoſophy and Mechanics, to the improvement of the Art of Cookery, are ſo evident, and ſo very important, that I cannot help flattering myſelf that we ſhall ſoon ſee ſome enlightened and liberal-minded perſon of the profeſſion take up the matter in earneſt, and give it a thoroughly *ſcientific* inveſtigation.

In what art or ſcience could improvements be made that would more powerfully contribute to increaſe the comforts and enjoyments of mankind?

And it muſt not be imagined that the ſaving of fuel is the only or even the moſt important advantage that would reſult from theſe inquiries:—in others, of ſtill greater magnitude, reſpecting the *manner* of preparing food for the table, would probably be derived from them.

The heat of boiling water, continued for a ſhorter or a longer time, having been found by experience to be ſufficient for cooking all thoſe kinds of animal and vegetable ſubſtances that are commonly uſed as food; and *that degree* of heat being eaſily procured, and eaſily kept up, in all places and in all ſeaſons; and as all the utenſils uſed in cookery are contrived for that kind of heat, few experiments have been made to determine the effects of uſing *other degrees of heat*, and *other mediums* for conveying it to the ſubſtance to be acted upon in culinary proceſſes. The effects of different degrees of heat in the ſame body are however ſometimes very ſtriking, and the taſte of the ſame kind of food is often ſo much altered by a trifling difference in the manner of cooking it, that it would no longer be taken for the ſame thing. What a ſurpriſing difference, for inſtance, does the manner of performing that moſt ſimple of all culinary proceſſes, *boiling in water*, make on potatoes!—Thoſe who have never taſted potatoes *boiled in Ireland*, or cooked according to the Iriſh method, can have no idea what delicious food theſe roots afford when they are properly prepared. But it is not merely the *taſte* of food that depends on the manner of cooking it; its nutritiouſneſs alſo, and its wholeſomeneſs, qualities ſtill more eſſential if poſſible than taſte, are no doubt very nearly connected with it.

Many kinds of food are known to be moſt delicate and ſavoury when cooked in a degree of heat conſiderably below that of boiling water; and it is more than probable that there are others which would be improved by being expoſed in a heat greater than that of boiling water.

In the ſea-port towns of the New England States in North America it has been a cuſtom, time immemorial, among people of faſhion, to dine one day in the week (Saturday) on *ſalt-fiſh*, and a long habit of preparing the ſame diſh has, as might have been expected, led to very conſiderable improvements in the art of cooking it. I have often heard foreigners who have aſſiſted at theſe dinners, declare that they never taſted ſalt-fiſh dreſſed in ſuch perfection; and I well remember that the ſecret of cooking it is to keep it a great many hours in water that is *juſt ſcalding hot*, but which is never made actually to boil.

I had long ſuſpected that it could hardly be poſſible that *preciſely* the temperature of 212 degrees of Fahrenheit's thermometer (that of boiling water) ſhould be that which is beſt adapted for cooking *all ſorts of food;* but it was the unexpected reſult of an experiment that I made with another view, which made me particularly attentive to this ſubject. Deſirous of finding out whether it would be poſſible to roaſt meat in a machine I had contrived for drying potatoes, and fitted up in the kitchen of the Houſe of Induſtry at Munich, I put a ſhoulder of mutton into it, and after attending to the experiment three hours, and finding it ſhewed no ſigns of being done, I concluded that the heat was not ſufficiently intenſe; and deſpairing of ſucceſs, I went home, rather out of humour at my ill ſucceſs, and abandoned my ſhoulder of mutton to the cook maids.

It being late in the evening, and the cook maids thinking perhaps that the meat would be as ſafe in the drying machine as anywhere elſe, left it there all night. When they came in the morning to take it away, intending to cook it for their dinner, they were much ſurpriſed to find it *already cooked*, and not merely eatable, but perfectly done, and moſt ſingularly well-taſted. This appeared to them the more miraculous, as the fire under the machine was gone quite out before they left the kitchen in the evening to go to bed, and as they had locked up the kitchen when they left it, and taken away the key.

This wonderful ſhoulder of mutton was immediately brought to me in triumph, and though I was at no great loſs to account for what had happened, yet it certainly was quite unexpected; and when I taſted the meat I was very much ſurpriſed indeed to find it very different, both in taſte and flavour, from any I had ever taſted. It was perfectly tender; but though it was ſo much done, it did not appear to be in the leaſt ſodden or inſipid; on the contrary, it was uncommonly ſavoury and high flavoured. It was neither boiled, nor roaſted, nor baked. Its taſte ſeemed to indicate the manner in which it had been prepared: that the gentle heat to which it had for ſo long a time been expoſed, had by degrees looſened the coheſion of its fibres, and concocted its juices, without driving off their fine and more volatile parts, and without waſhing away or burning and rendering rancid and empyrumatic its oils.

Thoſe who are moſt likely to give their attention to this little hiſtory will perceive what a wide field it opens for ſpeculation and curious experiment. The circumſtances I have related, however trifling and unintereſting they may appear to many, ſtruck me very forcibly, and recalled to my mind ſeveral things of a ſimilar nature which had almoſt eſcaped my memory. They recalled to my recollection the manner juſt deſcribed in which ſalt-fiſh is cooked in America; and alſo the manner in which *ſamp* is prepared in the ſame country. (See my Eſſay on Food.) This ſubſtance, which is exceedingly palatable and nouriſhing food when properly cooked, *is not eatable* when ſimply boiled. How many cheap articles may there be of which the moſt delicate and wholeſome food might be prepared, were the art and the *ſcience* of cooking them better underſtood? —

—But I beg my reader's pardon for detaining him ſo long with ſpeculations which he may perhaps conſider as foreign to the ſubject I promiſed to treat in this Eſſay.—To proceed therefore to thoſe inveſtigations which are more immediately connected with the conſtruction of Kitchen Fire-places.—

CHAP. I.

Of the imperfections of the Kitchen Fire-places now in common uſe.—Objects particularly to be had in view in attempts to improve them.—Of the diſtribution of the various parts of the machinery of a Kitchen.—Of the method to be obſerved in forming the plan of a Kitchen that is to be fitted up, and in laying out the work.

As the principal object of this publication is to convey ſuch plain and ſimple directions for conſtructing Kitchen Fire-places and Kitchen Utenſils as may eaſily be underſtood, even by thoſe who are not verſed in philoſophical inquiries, and who have not had leiſure to examine ſcientifically the principles on which the propoſed improvements are founded, I ſhall endeavour, in treating the ſubject, to make uſe of the plaineſt language, and to avoid as much as poſſible all obſtruſe and difficult inveſtigation.

It will be proper to begin by taking a curſory view of Kitchen Fire-places, as they are now commonly conſtructed, and to point out their defects; and ſhew what the objects are which ought principally to be had in view in attempts to improve them.

Of the imperfections of the Kitchen Fire-places now in common uſe.

The great fault in the conſtruction and arrangement of the Kitchens of private families now in common uſe in moſt countries, and particularly in Great Britain and Ireland, (a fault from which all their other imperfections ariſe,) is, that they are not *cloſed*. The fuel is burnt in a long open grate called a *kitchen-range;* over which the pots and kettles are freely ſuſpended, or placed on ſtands; or fires are made with charcoal in ſquare holes, called *ſtoves*, in a ſolid maſs of brick-work, and connected with no flue to carry off the ſmoke, over which holes ſtewpans or ſaucepans are placed on tripods, or on bars of iron, expoſed on every ſide to the cold air of the atmoſphere.

The loſs of heat and waſte of fuel in theſe Kitchens is altogether incredible; but there are other evils attending them, which are perhaps ſtill more important. All the various proceſſes in which fire is uſed in preparing food for the table are extremely unpleaſant and troubleſome in theſe Kitchens, not only on account of the exceſſive heat to which thoſe are expoſed who are employed in them, but alſo and more eſpecially on account of the *noxious exhalations* from the burning charcoal; and the *currents of cold air* in the Kitchen, which are occaſioned by the ſtrong draft up the chimney.

It is ſufficient to have once been in a kitchen when dinner was preparing for a large company,—or even merely to have met the cook coming ſweltering out of it, to be convinced that the buſineſs of cooking, as it is now performed, is both diſagreeable and unwholeſome: and it appears to me, that it would be no ſmall addition to the enjoyments of thoſe who are fond of the pleaſures of the table to know that they were procured with leſs trouble and with leſs injury to the health of thoſe who are employed in preparing them.

Another inconvenience attending open chimney Fire-places, as they are now conſtructed, is the great difficulty of preventing their ſmoking. In order that there may be room for all the pots and kettles which are placed over the fire, the grate, or *kitchen-range*, as it is called, muſt be very long,—and in order that the cook may be able to approach theſe pots, &c. the mantle of the chimney is made very high; conſequently the throat of the chimney is not only enormouſly large, but it is ſituated very high above the burning fuel; both of which circumſtances tend very much to make a chimney ſmoke, as I have ſhown in my Eſſay on Open Chimney Fire-places; and there does not appear to be any effectual remedy for the evil, without altering entirely the conſtruction of ſuch Fire-places.

Of the objects particularly to be had in view in attempts to improve Kitchen Fire-places.

The objects which ought principally to be attended to in the arrangement of a kitchen, are the following:

1*ſt*, Each boiler, kettle, and ſtewpan, ſhould have its ſeparate cloſed Fire-place.

2*dly*, Each Fire-place ſhould have its grate, on which the fuel muſt be placed, and its ſeparate aſh-pit, which muſt be cloſed by a door well-fitted to its frame, and furniſhed with a regiſter for regulating the quantity of air admitted into the Fire-place through the grate. It ſhould alſo have its ſeparate canal for carrying off the ſmoke into the chimney; which canal ſhould be furniſhed with a damper. By means of this damper and of the aſh-pit door regiſter, the rapidity of the combuſtion of the fuel in the Fire-place, and conſequently the rapidity of the generation of the heat, may be regulated at pleaſure. The economy of fuel will depend principally on the proper management of theſe two regiſters.

3*dly*, In the Fire-places for all boilers and ſtewpans which are more than eight or ten inches in diameter, or which are too large to be eaſily removed with their contents *with the ſtrength of one hand*, an horizontal opening juſt above the level of the grate muſt be made for introducing the fuel into the Fire-place; which opening muſt be nicely cloſed by a fit ſtopper, or by a double door. In the Fire-places which are conſtructed for ſmaller ſtewpans this opening may be omitted, and the fuel may be introduced through the ſame opening into which the ſtewpan is fitted, by removing the ſtewpan occaſionally for a moment for that purpoſe.

4thly, All portable boilers and ſtewpans, and eſpecially ſuch as muſt often be removed from their Fire-places, ſhould be *circular*, and they ſhould be ſuſpended in their Fire-places by their circular rims; but the beſt form for all fixed boilers, and eſpecially ſuch as are very large, is that of an oblong ſquare, and all boilers, great and ſmall, ſhould rather be *broad* and *ſhallow* than narrow and deep.

A circular form is beſt for portable boilers, on account of the facility of fitting them to their Fire-places; and an oblong ſquare form is beſt for large fixed boilers, on account of the facility of conſtructing and repairing the ſtrait horizontal flues under them and round them, in which the flame and ſmoke by which they are heated is made to circulate.

When large boilers are ſhallow, and when their bottoms are ſupported on the tops of narrow flues, the preſſure or weight of their contents being ſupported by the walls of the flues, the metal of which the boiler is conſtructed may be *very thin*, which will not only diminiſh very much the firſt coſt of the boiler, but will alſo greatly contribute to its *durability*; for the thinner the bottom of a boiler is, the leſs it is *fatigued* and *injured* by the action of the fire, and the longer of courſe it will laſt; which is a curious fact, that has hitherto been too little known, or not enough attended to in the conſtruction of large boilers.

5thly, All boilers, great and ſmall, ſhould be furniſhed with covers, which covers ſhould be conſtructed in ſuch a manner, and of ſuch materials as to render them well adapted for confining heat. Thoſe who have never examined the matter with attention would be aſtoniſhed on making the experiment to find how much heat is carried off by the cold air of the atmoſphere from the ſurface of hot liquids, when they are expoſed naked to it, in boilers without covers: but in culinary proceſſes it is not merely the loſs of heat which is to be conſidered;—a great proportion of the finer and more rich and ſavoury particles of the food are alſo carried off at the ſame time, and loſt, which renders it an object of ſerious importance to apply an effectual remedy to this evil.

As heat makes its way through wood with great difficulty, and very ſlowly, there would perhaps be no ſubſtance better adapted for conſtructing covers for boilers than it, were it not for the perpetual changes in its form and dimenſions which are occaſioned by alternate changes of dryneſs and moiſture, but theſe alterations are ſo conſiderable, and their effects ſo difficult to be counteracted, eſpecially when the form of the cover is circular, that for portable boilers, and for ſtewpans and ſaucepans, I ſhould prefer covers made of thin ſheets of tinned iron, or of *tin* as it is commonly called. Theſe covers (which muſt always be made *double*) have already been particularly deſcribed in my *Sixth* Eſſay.

Though boilers and ſtewpans ſhould never be uſed naked over an open fire, or otherwiſe than in cloſed Fire-places, yet it is not neceſſary in fitting up a kitchen to build as many ſeparate Fire-places as it may be proper to have boilers, ſtewpans, and ſaucepans; for the ſame Fire-place may be made to ſerve occaſionally for ſeveral boilers or ſtewpans. Thoſe however that are uſed in the ſame cloſed Fire-place muſt be all of the ſame diameter; and in order that their capacities may be different, they may be made of different depths.

As in the hurry of buſineſs in the kitchen, one ſtewpan or boiler might eaſily be taken for another, were their diameters to vary by only a ſmall difference, and were they not diſtinguiſhed by marks or numbers; to prevent theſe miſtakes their diameters, expreſſed in inches, ſhould be marked on ſome conſpicuous part; on their handles for inſtance, or on their brims, and alſo on their covers; and their Fire-places ſhould be marked with the ſame number.

To guard ſtill more effectually againſt all miſtakes reſpecting the ſizes of theſe utenſils, and the Fire-places to which they belong, the difference of the diameters of two boilers or ſtewpans ſhould never be leſs than *one whole inch.* In ſeveral private kitchens that have been conſtructed on my principles, their diameters have been made to vary by *two inches*, that is to ſay, they have been made of 6, 8, 10, 12, and 14 inches in diameter; and in order that thoſe of the ſame diameter might be of different capacities, they were made of three different depths, namely, $\frac{1}{3}$, $\frac{1}{2}$, and $\frac{2}{3}$ their diameter in depth. Not only the numbers which ſhew their diameters, but the fractions alſo which expreſs their depths are marked on their handles, or on their brims.

The ſize of a private kitchen, or the number and ſize of its ſeparate cloſed Fire-places, and of its boilers and ſtewpans, muſt be regulated by the ſize of the family, or rather by the ſtyle of living; for where ſumptuous entertainments are occaſionally provided for large companies, the kitchen muſt be ſpacious, and its arrangement complete, however ſmall the family may be, or however moderate the expences of their table may be in their ordinary courſe of living in private.

Yet when kitchens are fitted up on the principles I am deſirous of recommending, neither the ſize of the kitchen, nor the number or dimenſions of its utenſils, will occaſion any addition to the table expences of the family in their ordinary courſe of living when they have no company, which is an important advantage that theſe kitchens have over thoſe on the common conſtruction.

In large kitchens with open Fire-places, the kitchen range being wide and very roomy, an enormous quantity of fuel is ſwallowed up by it, even when only a very ſmall quantity of food is provided; but this unneceſſary waſte is completely prevented by cooking in boilers and ſtewpans properly fitted into ſeparate cloſed Fire-places.

More fuel is frequently conſumed in a kitchen range to boil a tea-kettle, than, with proper management, would be ſufficient to cook a dinner for fifty men.

Of the diſtribution of the various parts of the machinery of a kitchen.

Though the internal conſtruction of the Fire-places, and the means employed for confining and directing the heat generated in the combuſtion of the fuel, (ſubjects which have been thoroughly inveſtigated in my Sixth Eſſay,)—are matters of the firſt concern in the fitting up of a kitchen, yet theſe are not all that require attention; the diſtribution of the various parts of the machinery is a matter of conſiderable importance, for a good arrangement of the different inſtruments and utenſils;—of the boilers—ovens—roaſters, &c.—will tend very much to facilitate the buſineſs of cooking, and conſequently *to put the cook in good humour;* which is certainly a matter of ſerious importance.

Cooks in general are averſe to all new inventions, and this is not ſurpriſing, and ought by no means to be imputed to them as a fault. Accuſtomed *to work with their own tools*, they naturally feel awkward and embarraſſed when others are put into their hands; and to this we may add, that there is always a degree of humiliation felt by thoſe who, after having been accuſtomed to conſider themſelves, and to be conſidered by others, as maſters of their profeſſion, are required to learn any thing new, or to do any thing in any other manner than that in which they have always been accuſtomed to do it, and in the performance of which they have always acquired praiſe. It will not however be difficult to convince thoſe of the profeſſion who are poſſeſſed of a good underſtanding, and are above low and vulgar prejudices, that the alterations propoſed will moſt certainly meet with their approbation, *when they become better acquainted with them.*

The diſtribution of the parts of a kitchen muſt always depend ſo much on local circumſtances, that general rules can hardly be given reſpecting it; the principles, however, on which this diſtribution ought in all caſes to be made, *viz.* convenience to the cook, — cleanlineſs, — and ſymmetry, — are ſimple, and eaſy to be underſtood; and in the application of them, the architect will have a good opportunity of diſplaying his ingenuity, and ſhowing his taſte.

Should he condeſcend to conſult the cook in making theſe arrangements he will do wiſely, on more accounts than one.

Though the ſmoke from the Fire-places of the boilers may be conveyed almoſt to any diſtance in horizontal canals, yet it will in moſt caſes be adviſable to place the boilers near the chimney;—and it will in general, though not always, be beſt to place them all in one range, or rather in one maſs of brick-work.

Of the method of forming a plan of a Kitchen that is to be fitted up; and of laying out the work.

Before the plan of a kitchen which it is intended to fit up is made, an exact plan muſt be procured of the room in which it is to be conſtructed, in which plan all the doors and windows muſt be diſtinctly marked, and alſo the Fire-place, if there be one in the room, and the chimney. The number and the dimenſions muſt likewiſe be known of all the boilers and ſaucepans which are to be fitted up in the brick-work.

The readieſt way of proceeding in making a plan or drawing of the machinery of a kitchen is to form it on the plan of the room; and in doing this the work will be much facilitated by the following very ſimple contrivance.

Cut out of thick paſteboard, detached pieces to repreſent the boilers, — ſaucepans, — roaſters, — ovens, &c. which are to be fitted up in the brick-work, and placing theſe in different ways on the plan of the room, ſee in what manner they can beſt be diſpoſed, or arranged. As theſe models (which muſt be drawn to the ſame ſcale as that uſed in drawing the plan of the room) may be moved about at pleaſure, and placed in an infinite variety of different poſitions in regard to each other, and to the different parts of the room; the effect of any propoſed arrangement may be tried in a few moments, in a very ſatisfactory manner, without expence, and almoſt without any trouble.

To facilitate ſtill more theſe preliminary trials with theſe models of the boilers, &c. ſeveral ſlips of paſteboard, equal in width to the diſtance at which one boiler ought to be placed from the other in the brick-work, meaſured on the ſcale of the plan, ſhould be provided and uſed in placing the models of the boilers at proper diſtances from each other. This diſtance in fitting up or ſetting kitchen boilers and ſaucepans, I have commonly taken at the width of a brick, or 4½ inches, and I have allowed the ſame ſpace—(4½ inches)—for the diſtance of the ſide of the boiler from the outſide or front of the maſs of the brick-work in which it is ſet. When this point is ſettled, (that reſpecting the diſtance which ſhould be left between the boilers,) the arranging of the paſteboard models of the boilers on the plan will be perfectly eaſy.

As ſoon as the diſtribution of the various boilers, &c. is finally ſettled, a ground plan of the whole of the machinery ſhould be traced on the plan of the room; and a ſufficient number of ſections and elevations ſhould be drawn to ſhow the ſituations, forms, and dimenſions of the Fire-places, and of all the other parts of the apparatus.

When this is done,—and when the boilers and the materials for building are provided, and every thing elſe that can be wanted in fitting up the kitchen is in readineſs, the architect or *amateur* may proceed to the laying out of the work.

As this will not be found to be difficult, and as it is really a moſt amuſing occupation, I cannot help recommending it very earneſtly to gentlemen, and even to ladies,—to ſuperintend and direct theſe works.

I don't know what opinion others may entertain of theſe amuſements, but with regard to myſelf I own that I know of nothing more intereſting than the planning and executing of machinery, by which the powers of Nature are made ſubſervient to my views;—by which the very elements are bound as it were in chains, and made to obey my deſpotic commands.—And not my commands alone, but thoſe of all the human race to whoſe neceſſities and comforts they are made the faithful and obedient miniſters!

The firſt thing to be done in laying out the work when a kitchen is to be fitted up, is to draw with red or white chalk, or with a coal, a ground plan of the brick-work, of the full ſize, on the floor or pavement of the room. When the kitchen is neither paved nor floored, this drawing muſt of courſe be made on the ground. In this drawing, the aſh-pits, and the paſſages leading to them muſt be marked, and when the aſh-pit is to be ſunk into the ground, that is the firſt thing that muſt be executed.

As ſoon as this ground plan is ſketched out, the aſh-pit doors ſhould all be placed, and the foundations of the brick-work laid.

To aſſiſt the bricklayer, and prevent his making miſtakes, ſeveral ſections of the brick-work of the full ſize, and particularly ſections of all the boilers, repreſented as fixed in their Fire-places, ſhould be drawn on wide boards, or on very large ſheets of paper,—or they may be drawn with charcoal or red chalk on the ſides of the room. Theſe ſections of the full ſize, where the bricklayer can readily take meaſure of the various parts of the work to be performed, will be found very uſeful.

Before I proceed to give a more particular and minute deſcription of the various Kitchen Utenſils and other machinery which will be recommended, I ſhall lay before my reader an account, illuſtrated by drawings, of ſeveral complete kitchens that have already been conſtructed under my direction. I have been induced to adopt this method in treating my ſubject, from an opinion that the directions which ſtill remain to be given reſpecting the conſtruction of Kitchen Fire-places, and of Kitchen Utenſils, will more eaſily be underſtood when a general idea ſhall have been formed of ſome of thoſe kitchens which have already been conſtructed on the principles recommended.

CHAP. II.

Detailed accounts, illuſtrated by correct plans, of various Kitchens, public and private, that have already been conſtructed on the Author's principles, and under his immediate direction.

ONE of the moſt complete kitchens I have ever yet cauſed to be conſtructed is, in my opinion, that belonging to Baron de Lerchenfeld at Munich, and although its general form and the diſtribution of the machinery are very different from any thing that has been ſeen in this country;—ſo different that I ſhould, perhaps, doubt whether it would be prudent at the firſt outſet to recommend their adoption and exact imitation; yet, as this kitchen has been found to anſwer remarkably well; even to the entire ſatisfaction of the cook, who began however by entering his formal proteſt againſt it, I have thought it right to lay the following deſcription of it before my readers. Thoſe who are alarmed at the novelty of its appearance will be ſo good as to recollect that much may be done, as will hereafter be ſhown, by way of accommodating the plan to the idea of thoſe to whom it is too new not to appear extraordinary and uncouth.

Deſcription of a Kitchen in the Houſe of BARON DE LERCHENFELD *at* MUNICH.

PLATE I.

Fig. 1. This Plate ſhows a perſpective view of the Kitchen Fire-place ſeen nearly in front. The maſs of brick-work in which the boilers and ſaucepans are ſet, projects out into the room, and the ſmoke is carried off by flues that are concealed in this maſs of brick-work, and in the thick walls of an open chimney Fire-place which, ſtanding on it, on the farther ſide of it, where it joins to the ſide of the room, is built up perpendicularly to the ceiling of the room. At the height of about twelve or fifteen inches above the level of the mantle of this open chimney Fire-place, the ſeparate canals for the ſmoke concealed in its walls end in the larger canal of this Fire-place, which laſt-mentioned larger canal ſloping backwards, ends in a neighbouring chimney which carries off the ſmoke through the roof of the houſe into the atmoſphere.

An horizontal ſection of this open chimney Fire-place, at the level of the upper ſurface of the maſs of brick-work on which it ſtands, may be ſeen Plate III. fig. 5. In this ſection the vertical canals are diſtinctly marked, which carry off the ſmoke from the boilers into the chimney, as alſo the ſtoppers which are occaſionally taken away to remove the ſoot, when theſe canals are cleaned. Theſe ſtoppers, which are made of earthen ware burnt like a brick or tile, are eight inches long, ſix inches wide, and three inches thick, and on their outſides they have two deep grooves that form a kind of handle for taking hold of them. When they are fixed in their places, their joinings with the door-way into which they are fitted are made tight by filling up the crevices with moiſt clay. The canals are cleaned by means of a ſtrong cylindrical bruſh, made of hogs' briſtles fixed to a long flexible handle of twiſted iron wire.

The open chimney Fire-place was conſtructed in order that an open fire might be made on its hearth, (which, as appears by the plan, is on a level with, or is a continuation of the top or upper ſurface of the maſs of brick-work in which the boilers are ſet,) ſhould any ſuch fire be wanted; but the fact is, that although this kitchen has been in daily uſe more than five years, it has not yet been found neceſſary to light a fire in this place. When any thing is to be fried or broiled, the cook finds it very convenient to perform theſe proceſſes of cookery over the two large ſtoves that are placed in the front of this open Fire-place; as the diſagreeable vapour that riſes from the frying-pan or from the gridiron, goes off immediately by the open chimney: and theſe ſtoves ſerve likewiſe occaſionally for warming heaters for ironing, and alſo for burning wood to obtain live coals for warming beds, or for keeping up a ſmall fire for boiling a tea-kettle, or for warming any thing that is wanted in the family. When this fire is not wanted, the regiſter in the aſh-pit door is nearly cloſed, and the top of the ſtove is covered with a fit cover of earthen-ware, by which means the fire is kept alive for a great length of time, almoſt without any conſumption of fuel; and may at any time be revived and made to burn briſkly in leſs than half a minute, merely by admitting a larger current of freſh air.

The convenience in a family of being able to have a briſk fire in the kitchen in a moment, when wanted, and to check the combuſtion in an inſtant, without extinguiſhing the fire, and without even cooling the Fire-place, when the fire is no longer wanted, can hardly be conceived by thoſe who have not been uſed to any other methods of making and keeping up kitchen fires than thoſe commonly uſed in the kitchens in Great Britain.

It will certainly be confeſſed that neither ſcience nor art has done much either for ſaving labour or for ſaving expence,—either for convenience, comfort, cleanlineſs, or economy in the invention and management of a *kitchen range.*

Before I proceed to explain more minutely the different parts of this kitchen, it may be uſeful to give a general idea of the whole of it, taken together.

PLATE II.

Fig. 2. This figure ſhows a front view, or, more ſtrictly ſpeaking, an elevation of this kitchen. In this plan the aſh-pit doors with their regiſters are diſtinctly ſeen; and alſo the ends of the earthen ſtoppers which cloſe the openings into the Fire-places * of four of the principal boilers. The covers of the principal boilers †, as alſo of ſeveral of the ſtewpans, are ſeen above the level of the upper ſurface of the maſs of brick-work.

The height of this maſs of brick-work *a b*, meaſured from the floor or pavement of the kitchen, is juſt three feet.

Fig. 3. This figure ſhews an horizontal ſection of the maſs of brick-work in which the boilers, &c. are ſet, taken at the level of the horizontal flues, that carry off the ſmoke from the boilers, ſtew-pans, and ſaucepans, into the vertical canals which convey it into the chimney.

The ſmoke from three of the principal boilers, ſituated on the left-hand, is carried by ſeparate canals to a circular cavity, over which a large ſhallow boiler is placed, in which water is heated

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* For a particular account of theſe ſtoppers, ſee p. 30—188, and Plate I. figures 6, 7, and 8, Eſſay VI.

† For an account of theſe covers, ſee p. 18—187. and Plate I. figures 1 and 2, Eſſay VI.

(by this ſmoke) for the uſe of the kitchen, and more eſpecially for waſhing the plates and diſhes. This boiler is diſtinctly ſeen with its wooden cover, (conſiſting of three pieces of deal united by two pairs of hinges) in the figure 5, Plate III.

The five Fire-places on the left-hand ſide of the maſs of brick-work are repreſented without their circular grates, and the eight Fire-places that are ſituated on the right-hand, are ſhown with their circular grates in their places *.

The Fire-places of the four largeſt boilers, which are ſituated in front of the brick-work, have doors or openings, cloſed with ſtoppers, for introducing fuel into theſe Fire-places, and three of theſe openings are repreſented in the plan as being cloſed by their ſtoppers; while the fourth (that ſituated on the right hand) is ſhown open, or without its ſtopper.

As all the reſt of the Fire-places (or ſtoves as they would be called in this country) are without any lateral opening for introducing the fuel, when any fuel is to be introduced into one of theſe Fire-places the ſtewpan or ſaucepan muſt be removed for a moment for that purpoſe.

It will be obſerved that ſeveral of the horizontal canals that carry off the ſmoke from the boilers are divided into two branches, which unite at a little diſtance

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* For a particular deſcription of theſe circular grates, ſee p. 41—187. and Plate I. figure 3 and 4. In Great Britain theſe grates may be made very cheap of caſt iron.

diſtance from their Fire-places;—this contrivance is very uſeful, eſpecially for cloſed Fire-places that are without flues under the boilers, as it occaſions the flame to divide under the bottom of the boiler, and to play over every part of it in a thin ſheet.

The reaſon why flues were not made under theſe boilers was to render it poſſible to uſe occaſionally ſeveral boilers of different depths in the ſame Fire-place; a convenience of no ſmall importance in the kitchen of a private gentleman, who occaſionally gives dinners to large companies.

It will be perceived that in the Fire-places of all the ſtewpans and ſaucepans there are circular flues which oblige the flame to make one complete turn round the ſides of the veſſel, before it goes off into the horizontal canal; but I am far from being ſure that the ſaving of fuel, ariſing from this peculiar arrangement, is ſufficient to counterbalance the loſs of that great convenience that reſults from being able to uſe indifferently ſtewpans and ſaucepans of different depths in the ſame ſtove, which cannot be obtained while theſe circular flues remain.

They will indeed be rendered unneceſſary, provided that the flame be made to divide under the bottom of the veſſel, (which may be done by cauſing it to enter the horizontal canal by two oppoſite openings,) and provided that this canal be furniſhed with a good damper,—WHICH OUGHT NEVER TO BE OMITTED. Although, to avoid the confuſion that is apt to reſult from the delineation of a multitude of different objects in the ſame drawing, the dampers to the canals are all omitted in theſe plans, they muſt on no account be left out in practice; for they are of ſuch importance, that there is no poſſibility of managing fires properly without them: and as it is of very little importance whether they be placed near the fire or far from it, or what is their form, provided they be ſo conſtructed as to diminiſh at pleaſure, and occaſionally to cloſe entirely the canal by which the ſmoke makes its eſcape, it is not neceſſary for me to give any particular directions how they are to be made: indeed their conſtruction is ſo very ſimple, and ſo generally known, that it would be quite ſuperfluous for me to enlarge on that ſubject.

The dotted lines leading from the front of the brick-work to the Fire-places ſhow the poſition and dimenſions of the aſh-pits.

The whole length of the maſs of brick-work from A to B is eleven feet, and its width from A to C is ſeven feet four inches. The ſpace it occupies on the ground may be conceived to conſiſt of ſix equal ſquares of forty-four inches each, placed in two rows of three ſquares each; theſe two rows being joined to each other by their ſides, and forming together a parallelogram. And in laying out the work when a kitchen is to be fitted up on the plan here deſcribed, it will always be beſt to begin by actually drawing theſe ſix ſquares on the floor of the kitchen. Nearly the whole of the middle ſquare of the back row is occupied by the open chimney Fire-place, and by its thick hollow walls; and the greater part of the middle ſquare of the front row is left as a paſſage for the cook to come to the open chimney Fire-place, or rather to the ſtoves that are ſituated near it.

PLATE III.

Fig. 4. This figure, which repreſents a vertical ſection of the maſs of brick-work through the centres of the Fire-places of the four principal boilers, is chiefly deſigned to ſhow the conſtruction of thoſe Fire-places, and alſo that of the boilers. Sections of the circular grates on which the fires are made to burn under the boilers are here repreſented, and alſo ſections of the aſh-pits, and of the contractions of the Fire-places immediately below the grates *; and in one of the Fire-places, which is ſhown without its boiler, the openings of the branched canal by which the ſmoke goes off horizontally towards the chimney, are alſo marked.

Fig. 5. This figure ſhows a bird's-eye view of the upper ſurface of the brick-work, with all the boilers and ſaucepans in their places, except one;

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[*] For an account of the utility of theſe contractions, ſee Eſſay VI. page 43.

three of the principal boilers and one ſaucepan with their covers on; and the reſt of them without their covers. It likewiſe repreſents an horizontal ſection of the open chimney Fire-place, four inches above the level of the top of the maſs of brick-work in which the boilers and ſaucepans are ſet.

It is to be obſerved, that all the boilers, ſtewpans, and ſaucepans, are fitted into circular rings of iron, which are firmly fixed to the brick-work; and that they are ſuſpended in their Fire-places by their circular rims. All the ſtewpans and ſaucepans, that are not too large to be lifted with their contents in and out of their Fire-places with the ſtrength of one hand, have iron handles attached to their circular rims; but the four principal boilers, which are too large to be managed with one hand, have each two rings fitted to their rims. Theſe handles and rings are ſo conſtructed, that they do not prevent the ſaucepans and boilers from fitting the circular openings of their Fire-places; neither do they prevent their being fitted by their own circular covers.

It will doubtleſs be obſerved, that the four principal boilers ſhown in fig. 4. belonging to the kitchen I am now deſcribing, differ but very little in form from the boilers in common uſe, and conſequently that they are conſiderably deeper in proportion to their width than they ought to be, in order that the heat generated in the combuſtion of the fuel might act upon them to the greateſt advantage; but it is to be remembered that to each of theſe Fire-places there are other ſhallower boilers that are uſed occaſionally, which do not appear in theſe plans. There is however one advantage attending deep boilers, to which it may in ſome caſes be uſeful to pay attention, and that is, that they economize *ſpace* in a kitchen; and when their Fire-places are properly conſtructed, and above all when they are furniſhed with good regiſters and dampers, the additional quantity of fuel they will require will be too trifling to be conſidered. The walls of their Fire-places will abſorb more heat in the beginning, but who knows but that the greater part of this heat may not afterwards be emitted in rays, and at laſt find its way into the boiler? I could mention ſeveral facts that have lately fallen under my obſervation, which ſeem to render this ſuppoſition extremely probable.—This however is not the proper place to give an account of them.

As I have ſaid that no fire has yet been made in the open chimney Fire-place of the kitchen I am deſcribing, it may perhaps be aſked how this kitchen is warmed in cold weather. To this I anſwer, that it has been found that the maſs of brick-work is made ſufficiently hot by the fires that are kept up in it when cooking is going on every day, to keep the room comfortably warm in the coldeſt weather.

This anſwer will probably give riſe to another queſtion, which is;—how we contrive to prevent the room from being much too warm in ſummer? By opening one of the windows a very little, and by opening at the ſame time the regiſter of a wooden tube or ſteam-chimney, which, riſing from the cieling of the room, ends in the open air; and which is always opened to clear the room of vapour when it is found neceſſary, and eſpecially when the victuals are taken out of the boilers, or when any other operation is going on that occaſions the diffuſion of a conſiderable quantity of ſteam. The oblong opening of this ſteam-chimney may be ſeen Plate I. Fig. 1. in the ceiling, at the right hand corner of the room.

Near this corner of the room may likewiſe be ſeen a front view of the hither end of one large roaſter, and part of the front view of a ſmaller one ſituated by the ſide of it; both with their ſeparate Fire-place doors.

The Fire-place door of the larger roaſter, as alſo both its blow-pipes, are repreſented as being open; but the aſh-pit door of this roaſter is hid by the maſs of brick-work in which the boilers are ſet. A particular account of theſe roaſters will be given hereafter.

The dimenſions of the boilers in this kitchen are as follows:

	Wide at the brim.	Deep.
	Inches.	Inches.
One large boiler heated by ſmoke -	20	8
Two large boilers - - - - - -	16	16
Two ditto uſed occaſionally in the Fire-places of the two boilers laſt mentioned - - - - - - -	16	8
Two ſmaller boilers - - - -	12	12
Two ditto fitted to the ſame Fire-places	12	6

The diameters of the ſtewpans and ſaucepans are 12, 10, and 8 inches; and their depth is made equal to half their diameters.

The fuel burnt in this kitchen is wood; and the billets uſed are cut into lengths of about ſix inches.

Common bricks were uſed in the conſtruction of the Fire-places, but care was taken to lay them in mortar compoſed of clay and brickduſt, without any ſand, with only a very ſmall proportion of lime.

In this kitchen, as alſo in that which I am now about to deſcribe, the maſs of brick-work in which the boilers are ſet projects into the room from the middle of one ſide of it.

Deſcription of the KITCHEN *of the Hoſpital of* LA PIETA *at* VERONA.

PLATE IV. Fig. 6. This figure repreſents the ground plan of the maſs of brick-work in which the boilers are fixed, and the canals by which the ſmoke is carried off from the Fire-places into the Chimney. The ground covered by this maſs of brick-work, and by the area (y) between the boilers, may be conceived to be divided into ſix equal ſquares, of 43 inches, placed in two rows of three ſquares each. In the centres of four of theſe ſquares, namely, of thoſe which are ſituated at the ends of the rows, are placed four large circular boilers.—The middle ſquare of the front row is chiefly occupied by the

area which is left between the two front boilers; and one half of the middle ſquare of the back row is occupied by an open Chimney Fire-place, in the thick walls of which no leſs than ſix vertical flues are concealed, which carry off the ſmoke from the boilers and ſtew-pans into the Chimney.

The ſmoke from the fire which heats the large boiler P, (which boiler is 32½ inches in diameter,) on quitting its Fire-place, goes off in four ſeparate branches, which ſoon unite, and forming one canal, riſes up under the middle of the bottom of the neighbouring large boiler Q—makes one complete turn under that boiler, and, paſſing from thence towards the centre of the maſs of brick-work, circulates in canals divided into ſeveral branches under an iron plate that forms the bottom of an oven, which is ſituated under the hearth of the open chimney Fire-place. From under the bottom of this oven this ſmoke goes off obliquely, and, entering the bottom of the vertical canal p, goes off into the Chimney. The principal uſe of this oven is to dry the wood that is uſed as fuel in the Kitchen. The large boiler Q, that is heated by this ſmoke, is deſigned for warming water for the uſe of the Kitchen, and for various other purpoſes for which hot water is occaſionally uſed in the Hoſpital.

The boiler P is principally uſed in preparing food for the children in the Hoſpital.

The ſmoke from the fire which heats the boiler R, paſſing off in a canal which leads to the boiler S, there ſeparates, and paſſing round the ſides of the boiler S, and under a ſmall part of its bottom, unites again, and paſſes off into the chimney by the vertical canal r. The heat in this ſmoke, though it is ſufficient to *warm* the water in the boiler S, is not ſufficient to make it boil. In order that the contents of this boiler may occaſionally be made boiling hot, the boiler has a ſmall Fire-place of its own, ſituated immediately under the middle of its bottom; and when the water in the boiler has been previouſly made warm by the ſmoke from the boiler R, a very ſmall fire made under it, in its own ſeparate Fire-place, will make it boil. The ſmoke from this Fire-place goes off by its own ſeparate canal into the vertical canal s, ſo that it does not interfere at all with the ſmoke from the Fire-place of the boiler R; and in conſequence of this arrangement, the heating of the boiler S, by the ſmoke from this neighbouring Fire-place and by its own fire, may be going on at the ſame time.

The ſmoke from the ſmall boiler T, and from the ſtewpans U and W, goes off immediately by ſeparate horizontal canals into their ſeparate vertical canals (*t u* and *w*) that open into the chimney at the height of about 15 inches above the mantle of the open chimney Fire-place; and all the vertical canals, by which the ſmoke goes into the chimney, are furniſhed with dampers.

The ſide *b c* of the maſs of brick-work is placed againſt the middle of one ſide of the Kitchen, which is a large room; and the walls of the open chimney Fire-place *g h i k* are carried up perpendicularly to the cieling of the room. The hearth *l m n o* is on a level with the top of the brick-work in which the boilers are ſet.

As the principal boilers are deep, in order to provide ſufficient room for them, and a ſufficient depth for their aſh-pits, the foundation of the quadrangular maſs of brick-work *a b c d* was raiſed 16 inches above the pavement of the Kitchen, and on the three ſides of the maſs of brick-work *a b*, *a d*, and *d c*, which project into the room, there are two ſteps, 8 inches in height each, which extend the whole length of each of thoſe ſides; and for greater convenience in approaching the boilers, the uppermoſt ſtep is made two feet wide, and the area *y* is on a level with the top of this wide ſtep. The aſh-pit doors of the principal boilers are placed in the front of this ſtep, and the bottoms of the paſſages or door-ways into their Fire-places by which the fuel is introduced, are ſituated juſt on a level with its upper ſurface.

The maſs of brick-work in which the boilers are placed, is 10 feet 9 inches long, and 8 feet 2 inches wide; and it is elevated to the height of about 3 feet 2 inches above the top of the upper broad ſtep, by which it is ſurrounded on three ſides, and on which it appears to ſtand,

Deſcription of the Kitchen of the HOUSE OF CORRECTION *at* MUNICH.

PLATE IV. Fig. 7, and PLATE V. Fig. 8 and 9, repreſent the plans and ſections of this Kitchen.

Fig. 7. repreſents the ground plan of the brick-work in which the boilers, &c. are ſet, or rather an horizontal ſection of the brick-work at the level of the Fire-places, and of the canals for carrying off the ſmoke. In this Kitchen the fires are not made on circular iron-grates, as in that juſt deſcribed, but the fuel is burnt on grates or bars compoſed of bricks ſet edgewiſe, as may be ſeen by the plans. (See *b b b*, &c. Fig. 7.)

The two principal boilers (*l l*, Fig. 9.) are quadrangular, each being 3 feet long, 2 feet wide, and fifteen inches deep, furniſhed with wooden covers moveable on hinges; and they are both heated by one fire. That which is ſituated in the front of the brick-work, and immediately over the fire, is uſed for making ſoup; while the other, which is placed very near it, and on the ſame level, is uſed for boiling meat, potatoes, greens, &c. in ſteam. A ſmall quantity of water (about an inch in depth) being put into the ſecond boiler, the ſmoke from the firſt, which paſſes in flues under the ſecond, ſoon cauſes this water to boil, and fills the boiler with hot ſteam. The ſteam from the firſt boiler is alſo carried into the ſecond by means of a tube about $\frac{3}{4}$ of an inch in diameter, furniſhed with a cock, which forms a communication between the two boilers juſt below the level of their brims. This tube of communication is not expreſſed in the Plates.

The ſmoke having quitted the ſecond boiler, riſes up obliquely to the level of the top of the maſs of brick-work in which the before-mentioned boilers are ſet, and then circulates under a quadrangular copper veſſel, (expreſſed by dotted lines at A, Fig. 8,) 27 inches long, 19 inches wide, and 20 inches deep, deſtined for containing warm water for the uſe of the Kitchen. As this veſſel ſtands higher than the tops of the boilers, it is found to be very convenient for filling them with water; and as this water is kept warm by the ſmoke, this arrangement produces a conſiderable economy of fuel as well as of time. The water is drawn off from this veſſel, for uſe, by means of a braſs cock, which is not expreſſed in the drawing; and it is ſupplied with water from a neighbouring reſervoir, the entrance of the water being regulated by a regulating cock, or valve, furniſhed with a ſwimming ball.

The ſmoke, after it has circulated in flues under this veſſel, goes off into a vertical canal which conducts it into the chimney. This vertical canal, together with three others deſigned for a ſimilar uſe, (ſee *d d d d*, Fig. 7, and Fig. 9,) are ſituated in the thick walls of an open chimney Fire-place, (*n*, Fig. 8,) the hearth of which is on a level with the top of the maſs of brick-work in which the boilers are ſet. An horizontal ſection of theſe four vertical flues, taken at the height of 3 inches above the level of the hearth; and alſo an horizontal ſection of the brick-work of a roaſting-machine, (B, Fig. 8 and 9,) ſituated on the left of this open chimney Fire-place, are diſtinctly repreſented in the Figure 9.

Under the hearth of the Fire-place there is an open vault which ſerves as a magazine for fuel; and in the front wall of the Fire-place, above the mantle, juſt under the cieling of the room, there are two openings into the chimney, by which the ſteam that riſes from the boilers eſcapes into the chimney and goes off with the ſmoke.

The manner in which the flues are conſtructed under the different boilers, and the horizontal canal for carrying off the ſmoke from the round boilers into the chimney, are ſhewn in the fig. 7. The aſh-pit doors to the two principal round boilers, which are expreſſed by dotted lines, are oppoſite to E and F, Fig. 7.

The aſh-pit door belonging to the Fire-place of the large quadrangular boilers is ſituated oppoſite to G, Fig. 7. The reaſon why theſe aſh-pit doors were not placed immediately under their Fire-place doors is becauſe there was not room for them in that ſituation, owing to the pavement of the area between the boilers being raiſed one ſtep higher than the floor of the kitchen, which was done for the convenience of the Cook.

The openings for introducing the fuel into the Fire-places are conical holes in ſquare tiles, cloſed with earthen ſtoppers, (ſee page 30, Eſſay VI.)

Though theſe tiles are not particularly diſtinguiſhed in theſe plates, the ſtoppers which cloſe their conical openings are ſhewn. As theſe tiles are ſo worked into the maſs of the brick-work as to make a part of it, and as they are plaiſtered and white-waſhed in front, it is not eaſy to diſtinguiſh them from the bricks when the work is finiſhed. Their joinings with the bricks in front could not therefore with propriety be marked in any of theſe plans.

Although the roaſter belonging to the kitchen we are deſcribing is not ſeen, yet the maſs of brick-work in which it is fitted up appears on the left hand ſide of the open chimney Fire-place in Fig. 8; and a bird's-eye view of its Fire-place, and of the projecting edges of the bricks on which it reſts, are ſeen in the figure 9.

Deſcription of the new Kitchen in the MILITARY HOSPITAL *at* MUNICH.

PLATE VI. Fig. 10 and 11, and PLATE VII. Fig. 12.

The maſs of brick-work in which the boilers, the roaſter, the ſtewpans, &c. are ſet, occupies one corner of the Kitchen, extending 11½ feet on one ſide of the room, and 13 feet 7 inches on the other. The greateſt width of the maſs of brick-work (from A to B, or from C to D) is 50½ inches, and its height from the floor 36 inches. The circular area (E, Figures 9 and 10) in the angle of the maſs of brick-work is 6 feet 8½ inches in diameter; and it is raiſed one eaſy ſtep, or about 5 inches above the level of the floor of the room. There is an open chimney Fire-place of a peculiar form (F, Fig. 10) in the corner of this Kitchen, the hearth of which is on a level with, or rather makes a part of the upper ſurface of the maſs of brick-work. The ſide-walls of this open chimney Fire-place are hollow, (ſee G and H, Fig. 10,) and ſerve as canals for carrying off the ſmoke from the boilers into a chimney, which is ſituated quite in the corner of the room. Theſe canals open into the Chimney about 15 inches above the level of the mantle.

The ſmoke goes off from each Fire-place by two ſeparate and very narrow horizontal canals into larger common canals, (ſee I and K, fig. 9,) which conducts it to the Chimney; and the openings of theſe narrow canals are occaſionally cloſed more or leſs by means of ſmall pieces of brick or of earthen-ware, which ſerve inſtead of dampers, but which are not expreſſed in the Plates. The fires all burn on flat grates, compoſed of bricks, or thin tiles ſet edge-wiſe. To ſave expence the covers of the boilers and ſtewpans were all made of wood. The oblong quadrangular veſſel, (ſee L, Figures 10 and 11,) which is made of copper, and has a door above moveable on hinges, is deſtined for containing warm water for the uſe of the Kitchen, and is heated by the ſmoke from all the neighbouring cloſed Fire-places.

The Fire-place of the roaſter is ſeen in Figure 9 (M); a bird's-eye view of the top of the roaſter appears in Figure 10, and a vertical ſection of it and of its flues are faintly marked by dotted lines in Fig. 11.

The two large ſhallow ſtewpans, (N, O, Fig. 10,) vertical ſections of which, and of their Fire-places, are faintly marked by dotted lines in Fig. 11, are conſtructed of hammered iron, and are uſed principally for cooking ſteam dumplins, (dampf-nudels,) a kind of food in great repute in Bavaria.

When any thing is to be fried or broiled, a fire is made on the hearth of the open chimney Fire-place. Under this hearth there is a ſmall vault which ſerves for holding the wood that is wanted for fuel; but it would have been much better if that ſpace had been occupied by two circular cloſed Fire-places, ſo conſtructed as to be uſed occaſionally for a frying-pan or a gridiron.

Deſcription of a detached part of the Kitchen of the Military Academy at Munich.

PLATE VII. Fig. 13. This figure is the ground plan of a maſs of brick-work occupying a ſpace about 6 feet 9 inches ſquare, meaſured on the floor, in one corner of the room, in which two of the principal boilers belonging to the kitchen, and three large ſtewpans, are fixed.

A and B are two ſteps, each 8 inches high, and the upper (flat) ſurface of the maſs of brick-work, in which the boilers are ſet, and which is 45 inches wide, is juſt 30 inches above the level of the upper ſurface of the ſtep B.

Neither the boilers nor ſtewpans are ſhewn in this plan, but their circular fire-places are repreſented; as alſo their circular diſhing iron grates, on which the fuel is burnt, and the horizontal canals by which the ſmoke paſſes off into the chimney.

The ſmoke divides under each of the two principal boilers, and paſſes off in two canals ſituated on oppoſite ſides of the Fire-place; which canals, however, unite and form one ſingle canal at a ſmall diſtance from the boiler. In the Fire-places of the ſtewpans the ſmoke does not divide in this manner; but the Fire-place is ſo conſtructed, that the flame makes one complete turn round the ſtewpan before it goes off into the horizontal canal leading to the chimney.

The opening by which the fuel is introduced into the Fire-place of each of the two large boilers is cloſed by a conical ſtopper, (conſtructed of fireſtone,) repreſented in the figure, immediately under which ſtopper the (regiſter) door of the aſh-pot is ſituated.

The aſh-pit of each of the Fire-places of the ſtewpans is furniſhed with a regiſter door. The paſſages into theſe aſh-pits are expreſſed in the figure by dotted lines. The fuel (which is ſmall pieces of wood about 5 inches in length) is introduced into the Fire-place from above, by removing the ſtewpan for a moment for that purpoſe.

The chimney C, by which the ſmoke goes off, is ſituated in a corner of the room, and when it is ſwept, the chimney-ſweeper enters it by a door-way, which is ſituated in front, juſt above the level of the upper ſurface of the maſs of brick-work, and which is cloſed by an iron door.

Each of the horizontal canals by which the ſmoke is carried off from the Fire-places of the two large boilers into the chimney, is furniſhed with a damper, which is faintly marked in the figure. Each of the horizontal canals, which carry off the ſmoke from the Fire-places of the ſtewpans, is likewiſe furniſhed with a damper, but, to avoid confuſion, they are not expreſſed in the engraving.

The bottoms of the aſh-pit doors of the Fire-places of the three ſtewpans, are on a level with the upper ſurface of the ſtep B; but the bottoms of the aſh-pit doors of the Fire-places of the two large boilers are on a level with the pavement of the kitchen.

The two large boilers (which are conſtructed of ſheet copper, tinned,) are 22 Rhinland inches in diameter above,—19¼ inches in diameter below,—and 24 inches deep. They weigh each 62 lbs. Avoirdupois, and contain 28 wine gallons. The circular diſhing grates belonging to their Fire-places are each 10 inches in diameter, meaſured externally, and the Fire-place, properly ſo called, or the cavity in which the burning fuel is confined, is 10 inches in diameter below, 18 inches in diameter above, and 8½ inches deep.

The largeſt ſtewpan is 12 inches in diameter, and 4 inches deep; and the two others are each 11 inches in diameter, and 4 inches deep.

The Fire-places belonging to the ſtewpans are cylindrical,—5 inches deep, and 6 inches in diameter, and are furniſhed with circular diſhing grates.

Each of the large boilers is furniſhed with a circular wooden rim, 2 inches wide, and 2 inches thick, which is accurately fitted to the brim of the boiler; and a circular wooden cover, conſiſting of three pieces of deal board attached to each other by two pairs of hinges, cloſes the boiler by being fitted accurately to the upper ſurface of its circular wooden rim.

One of the three pieces of board, which together form the flat circular cover of the boiler, is firmly faſtened down to the wooden rim of the boiler, by means of two ſmall hooks of iron; and from the middle of this part of the cover, ſo faſtened down, a long tin tube, about 1¼ inches in diameter, riſes up perpendicularly to the cieling of the room, and carries off the ſteam from the boiler out of the kitchen.

As the cover of the boiler is compoſed of three flat pieces of board united by hinges, and as the cover, ſo formed, is merely laid down on the flat ſurface of the wooden rim which is connected with the brim of the boiler, it might very naturally be expected that ſome of the ſteam would be forced through between the joinings of the cover, or between the cover and the wooden rim; but this is what never happens:—So far from it, ſteam ſeldom comes into the room even when the cover of the boiler is in part removed, by laying back the firſt diviſion of it upon the ſecond—ſo ſtrong is the draught of the ſteam tube.

This phenomenon, which rather ſurpriſed me when I firſt obſerved it, was of conſiderable uſe to me; for it led me to diſcover the utility of dampers in the tubes, or chimnies, that are deſtined for carrying off the ſteam from boilers, and more eſpecially from ſuch boilers whoſe covers are not perfectly air-tight. If theſe ſteam-chimnies are of any conſiderable length, they cannot fail to occaſion a ſtrong draught through them, which will have a tendency to cauſe the cold air of the atmoſphere to preſs in by every crevice between the brim of the boiler and its cover; which ſtreams of cold air being precipitated upon the ſurface of the boiling liquid, will be there warmed; and then paſſing off rapidly by the ſteam-chimney, will occaſion a very conſiderable loſs of heat.

The rule for regulating the damper of the ſteam-chimney of a boiler, whoſe cover is not ſteam tight, is this;—cloſe the damper juſt ſo much, that cloſing it any more would cauſe ſome ſteam to be driven out between the joinings of the brim of the boiler and its cover. When this is done, it is evident that little or no cold air can enter the boiler by any ſmall crevices in its cover that may remain open, conſequently little or no heat will be carried off by the air of the atmoſphere from the ſurface of the hot liquid.

I have been the more particular in explaining this matter, as I am perſuaded that a great deal of heat is frequently loſt in boiling and evaporating liquids, by cauſing or permitting the cold air of the atmoſphere to come into contact with the ſurface of the hot liquid.

Some, I know, are of opinion, that a ſtream of freſh air, or a wind, which is made to paſs over the ſurface of a liquid that is evaporated by boiling, tends rather to increaſe the evaporation than to diminiſh it; but it appears to me that there are ſtrong reaſons to conclude that this opinion is erroneous. A very ſimple experiment, which I propoſe to make, and which others may perhaps be induced to make before I can find leiſure to attend to it, will determine the fact.

The large boiler belonging to the Fire-place, which is ſituated on the left hand in the maſs of brick-work above deſcribed, is that which was uſed in the Experiment mentioned in the ninth page of my Sixth Eſſay.

It was once my intention to have publiſhed drawings and deſcriptions of every part and detail of the kitchen of the Military Academy at Munich, and alſo that of the Houſe of Induſtry in that city; but as enough has already been ſaid in this and in my Sixth Eſſay to give clear and diſtinct ideas of the fundamental principles on which all the eſſential parts of the machinery in thoſe kitchens were conſtructed; and as the peculiar arrangement of a kitchen muſt ever depend much on its ſize, and on the variety and kinds of food that are to be cooked in it, to avoid being tedious and tireſome to my readers, I have, after mature deliberation, concluded that it will be beſt to ſuppreſs theſe details.

Having now finiſhed all the deſcriptions which I think it uſeful to publiſh of the various public and private kitchens that have been conſtructed under my direction in foreign countries, and having explained in the moſt ample manner in this Eſſay, and in my other writings on the Management of Fire, all the leading principles according to which, in my opinion, kitchens and fire-places of all kinds ſhould be conſtructed, I ſhall in the next place proceed to ſhow in what manner my plans may be ſo modified and accommodated to the opinions and practices in this country as to remove the objections that will probably be made to them, and facilitate their gradual introduction into general uſe.

I am well aware that it is by no means enough for thoſe who propoſe improvements to the public to be in the right in regard to the intrinſic merit of their plans: much muſt be done to prepare the way for, and to facilitate their introduction, or all their labours will be in vain.

CHAP. III.

Of the alterations and improvements that may be made in the Kitchen Fire-places now in common uſe in Great Britain.—All improvement in Kitchen Fire-places impoſſible, as long as they continue to be encumbered with ſmoke-jacks.—They occaſion an enormous waſte of fuel.—Common jacks, that go with a weight, are much better.—Ovens and boilers that are connected with a kitchen range ſhould be detached from it, and heated each by its own ſeparate fire.—The cloſed Fire-places for iron ovens and roaſters can hardly be made too ſmall.—Of the various means that may be uſed for improving the large open fire-places of kitchens.—Of the cottage Fire-places now in common uſe, and of the means of improving them.—Of the very great uſe that ſmall ovens conſtructed of thin ſheet iron would be of to cottagers.—Of the great importance of improving the implements and utenſils uſed by the poor in cooking their food.—No improvement in their method of preparing their food poſſible without it.—Deſcription of an oven ſuitable for a poor family, with an eſtimate of the coſt of it.—Of neſts of three or four ſmall ovens heated by one fire.—Of the utility of theſe neſts of ovens in the kitchens

kitchens of private families.—They may be fitted up at a very ſmall expence.—Occaſional remarks reſpecting the materials proper to be uſed in conſtructing the ſides and backs of open chimney Fire-places.

THE Kitchen Fire-place of a family in eaſy circumſtances in this country conſiſts almoſt univerſally of a long grate, called a Kitchen-Range, for burning coals, placed in a wide and deep open chimney with a very high mantle. The front and bottom bars of the grate are commonly made of hammered iron, and the back of the grate (which uſually ſlopes backwards) of a plate of caſt iron; and ſometimes there is a vertical plate of iron, moveable by means of a rack in the cavity of the grate, by means of which plate the capacity, or rather the length of that part of the grate that is occupied by the burning fuel, may occaſionally be diminiſhed. At one end of the grate there is commonly an iron oven, which is heated by the fire in the grate; and ſometimes there is a boiler ſituated in a ſimilar manner at the other end of it. To complete the machinery, (which in every part and detail of it ſeems to have been calculated for the expreſs purpoſe of *devouring fuel*,) a ſmoke-jack is placed in the Chimney!

I ſhall begin my obſervations on the ſmoke-jack.

No human invention that ever came to my knowledge appears to me to be ſo abſurd as this. A wind-mill is certainly a very uſeful contrivance, but

but were it propoſed to turn a wind-mill by an artificial current of air, how ridiculous would the ſcheme appear! What an enormous force would neceſſarily be waſted in giving velocity to a ſtream of air ſufficient to cauſe the mill to work with effect! A ſmoke-jack is, however, neither more nor leſs than a wind-mill, carried round by an artificial current of air: and to this we may add, that the current of air which goes up a chimney, in conſequence of the combuſtion of fuel in an open Chimney Fire-place, is produced in the moſt expenſive and diſadvantageous manner that can well be imagined. It would not be difficult to prove, that much leſs than *one thouſandth* part of the fuel that is neceſſary to be burnt in an open Chimney Fire-place, in order to cauſe a ſmoke-jack to turn a loaded ſpit, would anſwer to make the ſpit go round, were the force evolved in the combuſtion of the fuel properly directed; through the medium of a ſteam-engine, for inſtance.

But it is not merely the waſte of power, or of mechanical force, that unavoidably attends the uſe of ſmoke-jacks, that may be objected to them; they are very inconvenient in many reſpects: they frequently render it neceſſary to make a great fire in the kitchen, when otherwiſe a great fire would not be wanted: they very frequently cauſe chimnies to ſmoke, and always render a ſtronger current of air up the chimney neceſſary, than would be ſo merely for the combuſtion of the fuel wanted for the purpoſes of cooking; conſequently they increaſe the currents of cold air from the doors and windows to the Fire-place: and laſtly, they are troubleſome, noiſy, expenſive, frequently out of order, and never do the work they are meant to perform with half ſo much certainty and preciſion as it would be done by a common jack, moved by a weight or a ſpring.

There is, I know, an objection to common jacks that is well founded, which is, that they require frequent winding up; but for this there is an eaſy remedy. A jack may without any difficulty (merely by uſing a greater weight, and a greater combination of pullies) be made to run almoſt any length of time;—a whole day for inſtance, or even longer; and if it ſhould be neceſſary, the weight may be at a conſiderable diſtance from the kitchen. It may indifferently be raiſed up into the air,—deſcend into a well,—or may be made to deſcend along an inclined plane; and but little ingenuity will be required to contrive and diſpoſe of the machinery in ſuch a manner as to keep it out of the way, and if it ſhould be required, completely out of ſight: and with regard to the winding up of ſuch a jack as I here recommend, (that is, to go a whole day,) it may eaſily be done by any ſervant of the houſe, in leſs than five minutes.

Incomparably leſs labour will be required to wind up the weight of a common jack than to bring coals to feed the fire that is requiſite to make a ſmoke-jack go.

I know

I know that it is ſaid in favour of ſmoke-jacks, that all the fire that is required to make them perform would be neceſſary in the kitchen for other purpoſes, and conſequently that they occaſion no additional expence of fuel; but that this ſtatement is very far indeed from being accurate will be evident to any perſon who will take the trouble to examine the matter with care. That the ſails of a ſmoke-jack will turn round with the application of a very ſmall force, when the pivots, on which its axle-tree reſts, are well conſtructed, and when its motion is not impeded by any load, is very true; but it requires a very different degree of force to move it, when it is obliged to carry round one, or perhaps two or three loaded ſpits. Even the heat given off to the air by the kitchen range in cooking, after the fire is gone out, will ſometimes keep up the motion of the ſails of the ſmoke-jack for many hours. But what a ſtriking proof is this of the enormous waſte of fuel in kitchens in this country!

Would to God that I could contrive to fix the public attention on this ſubject.

Nothing ſurely is ſo diſgraceful to ſociety, and to individuals, as unmeaning waſtefulneſs.

But to return to the attack of my ſmoke-jack;—which (although it be a *wind-mill*) is certainly not a *giant*, and cannot be perſonally formidable, however it may expoſe me to another ſpecies of danger.

There is one objection to ſmoke-jacks that muſt be quite concluſive wherever the improvements I have recommended, and ſhall recommend, in Kitchen Fire-places, are to be introduced. Where ſmoke-jacks exiſt, theſe improvements cannot be introduced, it being quite impracticable to unite them.

On a ſuppoſition that I have gained my point, and that the ſmoke-jack is to be removed, I ſhall now proceed to propoſe ſeveral alterations and improvements that may be made in the Kitchen Range.

And, firſt, all ovens, boilers, ſteam-boilers, &c. which are connected with the back and ends of the range, and heated by the fire made in the grate, ſhould be detached from it, and for each of the ovens, boilers, &c. a ſmall, ſeparate, cloſed Fire-place muſt be conſtructed, ſituated *directly under* the oven or boiler, and furniſhed with a ſeparate canal for carrying its ſmoke into the Kitchen Chimney, which ſeparate canal may open into the Chimney about a foot above the level of the mantle.

There is nothing ſo waſteful as the attempt to heat ovens and boilers by heat drawn off laterally from a fire in an open grate. The conſumption of fuel is enormous, to ſay nothing of the expence of the machinery, and the inconvenience that muſt frequently ariſe from the heat being forcibly drawn away ſidewiſe under an oven or boiler, when it is wanted elſewhere.

The ſeparate cloſed Fire-place under iron ovens and roaſters muſt be made *very ſmall*, otherwiſe the cook or his aſſiſtants will ſometimes, in the hurry of buſineſs, make too large a fire; the conſequences of which will be the ſpoiling of the food, and the burning and deſtroying of the oven or roaſter.

Almoſt all the roaſters that have been put up in England have been ſpoiled in conſequence of their Fire-places being made too large; and not one has ever received the ſlighteſt accident or injury, or failed to perform to entire ſatisfaction, that has been heated by a very ſmall fire, and never over-heated.

The Fire-place for an oven or roaſter of ſheet-iron, from 18 to 20 inches wide, and from 24 to 30 inches long, ſhould never be more than 6 inches wide,—6 inches deep,—and about 9 or at moſt 10 inches long; and this Fire-place ſhould ſeldom be half-filled with coals. If the oven or roaſter be ſet in ſuch a manner that the flame or ſmoke from the fire muſt neceſſarily ſpread round it and embrace it on every ſide, there will be no want of heat for any of the common purpoſes of cookery, and its intenſity may at all times be regulated by means of the damper in the Chimney, and the Regiſter in the aſh-pit door.

It is not eaſy to imagine how much the buſineſs of cooking is facilitated by making the machinery ſo perfect, that the quantity of heat may at any time be regulated with certainty merely by regiſters and dampers, and without adding to or diminiſhing the quantity of fuel in the Fire-place. It is on theſe advantages, and the numerous other conveniences that will reſult from them, that my hopes are principally founded of gaining over the cooks, and engaging their cordial aſſiſtance in bringing forward into general uſe the improvements I recommend. I am well aware of their influence, and of the importance of their co-operation.

When all the ovens and fixed boilers are detached from the Kitchen range, then, and not before, meaſures may be taken with ſome proſpect of ſucceſs for improving the Kitchen Fire-place, ſo as to economiſe fuel, and prevent the Kitchen Chimney from ſmoking, if it has that fault; and the meaſures proper to be adopted for obtaining thoſe ends muſt depend principally on the ſize, or rather on the width of the open fire that will be wanted in the Kitchen. Where the family is ſmall, and where great dinners are ſeldom or never given, and eſpecially where cloſed roaſters are introduced, a ſmall Fire-place, and conſequently a narrow grate, will anſwer every purpoſe that can be wanted; and the Fire-place of the Kitchen may be fitted up nearly upon the principles laid down in my Fourth Eſſay, on the Conſtruction of open Chimney Fire-places.

The Kitchen of Mr. Summers, Ironmonger, of New Bond Street, (No. 98,) has been fitted up in this manner, and has been found to anſwer perfectly well.

But if it be neceſſary to leave the grate of the Kitchen Range with its width undiminiſhed, in order that a wide fire may occaſionally be lighted in it, this can beſt be done in the manner that was lately adopted in altering and fitting up the Kitchen in the houſe of the Counteſs of Morton in Park Street. The range being ſuffered to remain (or rather the front and bottom bars of the grate only, for the iron plate that formed the back of the range was taken away);—the range, which is about five feet long, was divided into three unequal parts, which parts were built up with hard fire-bricks in ſuch a manner as to form three diſtinct Fire-places, the one contiguous to the other, and ſeparated from each other by diviſions ſo thin in front, that when fires are burning in them all it appears like one fire, and has all the effect of one fire in roaſting meat that is put before it. Each Fire-place is, however, perfectly diſtinct from the others, and has its own diſtinct covings, (which are oblique,)—back, throat, &c. though the ſame front bars, which are of hammered iron, and made very ſtrong, run through them all.

When a very ſmall fire is wanted, (merely for boiling a tea-kettle, for inſtance,) it is kindled in the *firſt* or ſmalleſt Fire-place: when a little larger fire is neceſſary, it is made in the *ſecond* Fire-place, which is at the oppoſite end of the range: when a ſtill larger fire is required, it is made in the *third* Fire-place, which occupies the middle of the range. If a large fire in the fourth degree is wanted, two neighbouring fires are kindled in the *firſt* and *third* Fire-places: if in the fifth degree, the two contiguous fires are lighted in the ſecond and third Fire-places; and when the greateſt fire that can be made is wanted, all the three Fire-places are at the ſame time filled with burning fuel.

In caſes where a ſingle open Chimney Fire-place of a moderate ſize, that is to ſay, from 18 to 20 inches in width, might ſometimes be too ſmall, and a very wide fire, like that juſt deſcribed, would never be wanted, I would adviſe the conſtruction of two ſeparate but adjoining Fire-places, the one about 12 inches, and the other about 18 or 20 inches in width. Theſe would, I imagine, anſwer every purpoſe for which an open fire in the kitchen could be wanted by a large family, even though they ſhould (contrary to all my recommendations) continue to roaſt their meat upon a ſpit.

That I am not unreaſonable enough to expect that all my recommendations will immediately be attended to, is evident from the pains I take to improve machinery now in uſe, of which I do not approve, and which is perfectly different from that I am deſirous to ſee introduced.

When my roaſters ſhall become more generally known, and the management of them better underſtood,

ſtood, I have no doubt but that open Chimney Fire-places, and open fires of all deſcriptions, will be found to be much leſs neceſſary in kitchens than they now are.

I am even ſanguine enough to expect that the time will come when open fires will diſappear, even in our dwelling rooms and moſt elegant apartments. Genial warmth can certainly be kept up, and perfect ventilation effected much better without them than with them; and though I am myſelf ſtill child enough to be pleaſed with the brilliant appearance of burning fuel, yet I cannot help thinking that ſomething elſe might be invented equally attractive to draw my attention and amuſe my ſight, that would be leſs injurious to my eyes,—leſs expenſive,—and leſs connected with dirt, aſhes, and other unwholeſome and diſagreeable objects.

It is very natural to ſuppoſe that thoſe nations who inhabit countries where the winter is moſt ſevere, muſt have made the greateſt progreſs in contriving means for making their dwellings warm and comfortable in cold weather; and when, in milder climates, the growing ſcarcity of fuel has rendered the ſaving of that article an object of rational economy, it appears to me to be wiſe to ſearch *there* for the means of doing it, where neceſſity has long ſince rendered the uſe and higheſt poſſible improvement of thoſe means indiſpenſable. And the truly liberal,—that is to ſay, the enlightened, juſt, and generous,—feel no difficulty in acknowledging

ing the ingenuity and induſtry of their neighbours, and no humiliation in adopting their uſeful inventions and improvements.

Before I finiſh this publication I muſt ſay a few words on the conſtruction of *Cottage Fire-places.* It is, I am ſenſible, a long time ſince I promiſed to publiſh an Eſſay on that ſubject, and ſtill mean to do ſo; but a variety of weighty conſiderations have engaged me to poſtpone the putting of that Eſſay out of my hands. I conceived the ſubject to be of very great importance, and wiſhed to have time to make myſelf fully acquainted with the preſent ſtate of cottages, and of the different kinds of fuel uſed in them in different parts of theſe kingdoms.—I had with pain obſerved the numerous miſtakes that have been made in altering Chimney Fire-places on the principles recommended in my Fourth Eſſay, and on that account I was very deſirous of deferring the publication of my directions for conſtructing Cottage Fire-places, till I could inform the public where Cottage Fire-places, conſtructed on the principles recommended, might be ſeen.

I hope and truſt that in the arrangement of the repoſitory of the Royal Inſtitution, now fitting up in this metropolis, an opportunity will be found for exhibiting Cottage Fire-places on the moſt perfect plans, as alſo of ſhowing many other mechanical contrivances that may be of general utility.

Cottage Chimnies, as they are now commonly conſtructed in moſt parts of Great Britain, have a very wide open Fire-place, with a high mantle, and large chimney corners, in which the children frequently ſit on little ſtools, when in cold weather they hover round the fire. Theſe chimney corners are very comfortable; and except the whole room could be made equally ſo, it would certainly be a pity to deſtroy them; but this, I am perſuaded, may eaſily be done: in the mean time, much may be done to make cottages warm and comfortable, merely by a few ſimple alterations in their preſent Fire-places.

As the principal fault of theſe Fire-places is the enormous width of the throats of their chimnies, which frequently occaſions their ſmoking, and always gives too free a paſſage for the warm air of the room to eſcape up the chimney, a ſmaller Fire-place may be conſtructed in the midſt of the larger one, and the little chimney of this ſmall Fire-place being carried up perpendicularly in the middle of the large Fire-place, the large chimney corners, without being deſtroyed, may be arched over and cloſed in above, ſo as to leave no paſſage in thoſe parts for the eſcape of the warm air of the room into the chimney, and from thence into the atmoſphere.

The back of the old chimney may ſerve for a back to the new Fire-place, and the jambs of the new chimney need not project forward beyond the back more than 12 or 15 inches; ſo that the new chimney, and every part of it, may be completely included within the opening of the old Fire-place. This is to be done in order to preſerve the old chimney corners; but in caſes where the opening of the old Fire-place is not ſufficiently wide, high, and deep, to permit of the leaving of chimney corners ſufficiently ſpacious to be uſeful, it will be beſt to ſacrifice theſe corners, and to proceed in a different manner in conſtructing the new Fire-place.

In this laſt caſe the back of the new Fire-place ſhould be brought forward, and the new work ſhould be executed agreeably to the directions contained in my Fourth Eſſay for the conſtruction of open Chimney Fire-places. If void ſpaces ſhould remain on the right and left of the new jambs, they will be found uſeful for various purpoſes.

It is of ſo much importance to facilitate the means of cooking to the poor, and enabling them to prepare food in different ways, that I think it extremely deſirable that each cottager ſhould have an *iron pot* or *digeſter*, ſo contrived as to be uſed occaſionally over his open fire, or, what will be much more economical, in a ſmall cloſed Fire-place, which may be made with a few bricks on one ſide of his open Fire-place.

But what would be of more uſe, if poſſible, to a poor family, even than a good boiler, would be a *ſmall oven* of ſheet iron, well put up in brick-work. Such an oven would not coſt more than a few ſhillings; and if properly ſet, would laſt for many years without needing any repairs. It would anſwer not only for baking houſehold bread and cakes, but might likewiſe be uſed with great advantage in cooking rice puddings, potatoe pies, and many other kinds of nouriſhing food of the moſt exquiſite taſte, that might be prepared at a very trifling expence.

It is in vain to expect that the poor ſhould adopt better methods of chuſing and preparing their food, till they are furniſhed with better implements and utenſils for cooking.

I put up an oven like that I now recommend laſt winter in my lodgings at Brompton, and have made a great number of experiments with it, from the reſults of which I am fully perſuaded of its utility. I pulled it down on removing into the houſe I now occupy, but mean to put it up again as ſoon as my kitchen ſhall be ready to receive it. As I put up this oven merely as an experiment, in order to aſcertain by actual trials how far it might be uſeful to poor families, the oven was made ſmall, and it was ſet in the cheapeſt manner, merely with common bricks and mortar, without any iron or other coſtly material. The grate of the cloſed Fire-place (which was 5 inches wide and about 8 inches long) was conſtructed of three common bricks placed edgewiſe, and a ſliding brick was uſed for cloſing the door of the Fire-place, and another for a regiſter to the aſh-pit door-way. The oven, which is of thin ſheet iron, is $18\frac{1}{2}$ inches long, 12 inches wide, and 12 inches high,—and it weighs juſt $10\frac{1}{2}$ lb. excluſive of its front frame and front door, which together weigh $6\frac{1}{4}$ lb.

For a ſmall family the oven might be made of a ſmaller ſize,—11 inches wide for inſtance, 10 inches high, and 15 inches long; and it is not indiſpenſably neceſſary that it ſhould have either a front frame or a front door of iron. It might be ſet in the brick-work without a frame, perfectly well; and a flat twelve-inch tile, or a flat piece of ſtone, or even a piece of wood, placed againſt its mouth, might be made to anſwer inſtead of an iron door.

The only danger of injury to theſe ovens from accident to which they are liable, is that ariſing from careleſneſs in making too large a fire under them. They require but a very ſmall fire indeed, and a large one is not only quite unneceſſary, but detrimental on ſeveral accounts. For greater ſecurity againſt accidents from too ſtrong fires, I would adviſe the Fire-place to be made extremely—I had almoſt ſaid—ridiculouſly ſmall; not more than from 4 to 5 inches wide, from 6 to 8 inches long, and about 5 inches deep; and I would place the bottom or grating of the Fire-place 11 or 12 inches below the bottom of the oven. For ſtill greater ſecurity, the bottom of the oven, immediately over the fire might, if it ſhould be found neceſſary, be defended by a thin plate of caſt, hammered, or ſheet iron, full of ſmall holes (as large as peas), placed about half an inch from the bottom of the oven, and directly below it: but if any common degree of attention be uſed in the management of the fire, this precaution will not, I am perſuaded, be neceſſary.

In ſetting theſe ovens, care muſt be taken that room be left for the flame and ſmoke to come into contact with the oven, and ſurround it on every ſide; and it can hardly be neceſſary to add, that a canal muſt be made by which the ſmoke can afterwards paſs off into the chimney.

I once imagined that ſmall ovens for poor cottagers might be made very cheap indeed, by making only the bottom of the oven of iron, and building up the reſt with bricks; but on making the experiment, it was not found to anſwer. I cauſed ſeveral ovens on this principle to be conſtructed in my kitchen, and made many attempts to correct their faults; but I found it impoſſible to heat them equally and ſufficiently. I then altered my plan, by making both the bottom and the top of ſheet iron. But this even did not anſwer. It might anſwer, and certainly would anſwer, for a perpetual oven, like that which I cauſed to be made in the Houſe of Induſtry at Dublin; but if an oven of this kind is ever ſuffered to become cold, it will require a long time to heat it again, which is a circumſtance that renders it very unfit for the uſe of a poor family. The ovens I have recommended, conſtructed entirely of thin ſheet iron, have the advantage of being heated almoſt in an inſtant, and the heat which penetrates the walls of their cloſed

Fire-places being gradually given off after all the fuel is burnt out, keeps them hot for a long time. Care ſhould, however, always be taken to keep theſe ovens well cloſed when they are uſed, and to leave only a very ſmall hole, when neceſſary, for the eſcape of the generated ſteam or vapour.

For larger families the oven may be made larger in proportion; or, what will be ſtill more convenient, a neſt of two, three, or four ſmall ovens, placed near to each other, may be ſo ſet in brick-work as to be heated by one and the ſame fire.

A neſt of four ſmall ovens, ſet in this manner, was fitted up in the kitchen of the Military Academy at Munich, and found very uſeful: they were rectangular, each being 10 inches wide, 10 inches high, and 16 inches long; and they were placed two a-breaſt in two rows, one immediately above the other, the ſides and bottoms of neighbouring ovens being at the diſtance of about 1½ inch that the flame and ſmoke which ſurrounded them on every ſide, might have room to paſs between them. The Fire-place was ſituated immediately below the interval that ſeparated the two lowermoſt ovens, at the diſtance of about 10 inches below the level of their bottoms; and by means of dampers the flame could be ſo turned and directed as to increaſe or diminiſh the heat in any one or more of the ovens at pleaſure.

Theſe four ovens were furniſhed with iron doors, moveable on hinges, which, in order that they might not be in the way of each other, opened two to the right and two to the left.

In a large kitchen, where a variety of different kinds of food are baked at the ſame time, or on the ſame day, it is eaſy to perceive, that a neſt of ſmall ovens muſt be very uſeful, much more ſo than one large oven equal in capacity to them all; for beſides the inconvenience in cooking a variety of different things in the ſame oven, that ariſes from the promiſcuous mixture of various exhalations and ſmells, the proceſs going on in one diſh muſt often be diſturbed by opening the oven to put in, or take out another, and the heat can never be ſo regulated as to ſuit them all.

But the cook of the Military Academy at Munich finds the neſt of ovens uſeful, not merely for baking: he uſes them alſo for ſtewing and for boiling, with great ſucceſs. A large quantity of cold liquid cannot, it is true, be heated and made to boil in a very ſhort time in one of theſe ovens, but a ſaucepan or boiler, whoſe contents are already boiling-hot, being placed in one of them, a gentle boiling may be kept up for a great length of time, with the conſumption of an exceedingly ſmall quantity of fuel.

With regard to the expence or coſt of ſuch a neſt of ovens, it could not, or at leaſt ought not to be conſiderable. If they were each 12 inches wide, 12 inches high, and 16 inches long, they would not weigh more than 15 lb. each, their doors included;

cluded; and this would make but 60 lb. for the weight of the whole neſt, ſuppoſing it to conſiſt of four ovens. I do not know what price might be demanded by the artificers in this country, or by the trade, for work of this kind, but I ſhould think they might well afford to ſell theſe ovens, properly made, and ready for ſetting, at leſs than 6d. the pound, avoirdupois weight. The ſheet iron would coſt them in the market, at the firſt hand, not more than about 3½ d. *per* pound. The expence of ſetting the ovens would not be conſiderable, eſpecially as only one ſmall Fire-place would be neceſſary.

In ſome future publication, or in a ſubſequent part of this Eſſay, I ſhall give a deſign of one of theſe neſts of ovens, with an exact eſtimate of the expence of it; in the mean time I will endeavour to get one of them put up for the public inſpection at the Royal Inſtitution.

I cannot cloſe this Chapter without once more calling the attention of my reader to the neceſſity of furniſhing the canal that carries away the ſmoke into the chimney with a damper. If this is not done in ſetting the ovens I have juſt been deſcribing, it will be quite impoſſible to manage the heat properly. For the Fire-place of a ſmall oven for the family of a cottager, a common brick may be made to anſwer very well as a damper; and, indeed, a very good damper for any ſmall Fire-place may be made with a brick, or a tile, or a piece of ſtone.

If, in addition to the introduction of a good damper, care be taken to cauſe the ſmoke to *deſcend* about 12 or 15 inches juſt after it has quitted the oven (or the boiler), and before it is permitted to riſe up and go off into the chimney, this will greatly contribute to the economy of fuel.

It is ſurely not neceſſary that I ſhould again obſerve how very eſſential it is in altering open Chimney Fire-places,—whether they belong to kitchens,—to the dwelling-rooms of the opulent,—or to cottages, to build up their backs and ſides,—in that part eſpecially which contains and is occupied by the burning fuel,—with fire-bricks or with ſtone; and never in any caſe to kindle a fire againſt a plate of iron.

If all the metal in a regiſter ſtove, except the front, and the front and bottom bars, were removed, and the back and ſides built up properly with fire-bricks, or partly with fire-bricks and partly with fire-ſtone, it would make a moſt excellent Fire-place.

This laſt obſervation is, I acknowledge, in ſome degree foreign to my preſent ſubject; but as it is well meant, I hope it will be well received.

In a Supplementary Eſſay now preparing for the preſs, in which will be publiſhed ſuch additional remarks and obſervations to all my former Eſſays as may be neceſſary to their complete explanation and elucidation, I ſhall take occaſion to enter fully into the ſubject of Chimney Fire-places, and ſhall endeavour to ſhow, at ſome length, why it is improper and ill-judged to conſtruct the ſides and backs of their grates of iron, or of any other metallic ſubſtance.

In a Second Part which will be added to this (Tenth) Eſſay, particular directions will be given for conſtructing boilers, ſteam diſhes, ovens, roaſters, and various other implements and utenſils uſed in cookery; and a detailed plan will be laid before the public for improving the kitchen utenſils of cottagers and other poor families.

I have been induced to reſerve theſe various matters for a ſeparate publication, in order to accommodate my writings as much as is poſſible to the convenience of the various claſſes of readers into whoſe hands they are likely to come. The Plates, which were indiſpenſably neceſſary to elucidate the deſcriptions contained in the preceding Chapters, (which have been admirably executed by that excellent artiſt Lowry,) could not fail to enhance very conſiderably the price of this publication, and on that account I was deſirous to detach and publiſh ſeparately all ſuch popular parts of the ſubjects I have undertaken to treat in this Eſſay, as appeared to me to bid fair to be moſt read, and to be of moſt general utility.

Whether the reader agrees with me or not in reſpect to the validity of the reaſons which have determined my judgment on this occaſion, I hope and truſt that he will do me the juſtice to believe, that I have no wiſh ſo much at my heart as to render my labours of ſome real and laſting utility to mankind. How happy ſhall I be when I come to die, if I can *then* think that I have lived to ſome uſeful purpoſe!

The End of the FIRST PART of the TENTH ESSAY.

APPENDIX

TO THE

FIRST PART OF THE TENTH ESSAY.

An account of the expence of fitting up a ſmall Oven.

SINCE the foregoing ſheets were printed off, I have cauſed a ſmall oven of ſheet iron to be made, and ſet in brick-work, for the expreſs purpoſe of aſcertaining the coſt of it. This oven, which is ſuch as would be proper for the uſe of a ſmall poor family, is 11 inches wide, 11 inches high, and 15½ inches long; and it weighs 6 lb. 2 oz. At its mouth or opening, the ſheet iron is turned back in ſuch a manner as to form a rim, half an inch wide, projecting outwards; which rim ſerves to ſtrengthen the oven, and is likewiſe uſeful in fixing it in the brick-work.

The whole oven is conſtructed of two pieces of ſheet iron, of unequal dimenſions, the largeſt piece (which is about 16½ inches wide by 45 inches long) forming the top, bottom, and two ſides; and the ſmalleſt (which is about 12 inches ſquare) forming the end. Theſe ſheets of iron are united by ſeams without rivets. One ſeam only runs through the oven in the direction of its length, and that is ſituated in the middle of the upper part of it.

A good workman was employed juſt two hours in making this oven, but there is no doubt but the work might be done in a ſhorter time by a man accuſtomed to that kind of manufacture, eſpecially if the proper means were uſed for facilitating and expediting the labour.

The ſheet iron uſed in the conſtruction of this oven,—which was of the very beſt quality,—coſt 34 s. *per* groſs hundred of 112 lb. which is at the rate of 3½ d. and $\frac{3}{14}$ of a farthing *per* lb.—The quantity uſed—6 lb. 2 oz. muſt therefore have coſt 1 s. 10½ d. and $\frac{1}{112}$ part of a farthing.

If now we allow two ounces for waſtage, this will bring the quantity neceſſary for conſtructing one of theſe ovens to 6¼ lb. which quantity, at the rate above mentioned, would coſt ſomething leſs than 1 s. 11 d.; and if to this ſum we add 1 s. for the making, this will bring the prime coſt of the oven to 2 s. 11 d.

Let us allow 20 *per cent.* for the profit of the manufacturer, and ſtill the price of the oven to buyers will be only 3 s. 6 d. *

In order to aſcertain the expence of ſetting one of theſe ovens in brick-work, I cauſed that above deſcribed to be put up in the middle of a wide chimney Fire-place in my houſe in Brompton-Row; and the work was executed with as much care and attention as was neceſſary, in order to render it ſtrong and durable. In doing this 114 bricks were uſed, and ſomething leſs than 3 hods of mortar; and the bricklayer performed the job in 3 hours and 10 minutes.

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* The oven I have here deſcribed was made by Mr. Summers, ironmonger, of New Bond-ſtreet, who, before I acquainted him with the above computations, offered to furniſh theſe ovens in any quantities at 4 s. a-piece. This, for the offer of a manufacturer, I thought not unreaſonable.

Three bricks ſet edgewiſe formed the grate or bottom of the Fire-place; the middle brick being placed vertically, and thoſe on each ſide of it inclining a little inwards above, to give a more free paſſage to the falling aſhes.

The entrance into the Fire-place was cloſed with a ſliding brick, and another brick ſerved as a regiſter to the aſh-pit door-way; a third ſerved as a damper to the canal that carried off the ſmoke into the chimney; and the oven itſelf was cloſed with a twelve-inch tile.

The expence of ſetting this oven was eſtimated as follows:

	s.	d.
114 bricks, at 3s. *per* hundred -	3	4
3 hods of mortar, at 4d. - -	1	0
1 twelve-inch tile, at 4d. - -	0	4
Bricklayer's labour - - -	1	6
Total	6	2
If to this ſum we add the amount of the ironmonger's bill for the oven -	3	6
The whole expence will turn out -	9	8

The maſs of brick-work in which this oven is ſet is juſt 2 feet wide, 19½ inches deep, meaſured from front to back,—and 3 feet 3½ inches high. The chimney Fire-place in which it is placed is 3 feet wide, 3 feet 3½ inches high, and 20 inches deep.

If the oven had been ſet in one corner of this Fire-place, inſtead of occupying the middle of it, near one quarter of the bricks that were uſed might have been ſaved; but if in building a new chimney a convenient place were choſen and prepared for it, an oven of this kind might be put up at a very ſmall expence indeed; perhaps for 3s. or 3s. 6d., which would reduce the coſt of the oven, when ſet, to about 7s. or 7s. 6d.

Though the bricklayer was above 3 hours putting up this oven, yet, as it was the firſt he ever ſet, there is no doubt but that he was conſiderably longer in doing the work on that account. He thinks he could put up another in two hours, and I am of the ſame opinion.

I think it would be adviſeable, in order to facilitate ſtowage and carriage of theſe ſmall ovens, always to manufacture them in neſts of four, one within the other, even when they are deſigned to be ſold, and to be put up ſingly; for it can be of no great importance whether they be a quarter of an inch or half an inch wider, or narrower; and it will often be a great convenience to be able to pack them one within the other, eſpecially when they are to be ſent to any conſiderable diſtance.

If care be taken in making them, to preſerve their forms and dimenſions, and if the ſeams of the metal be properly beaten down, the difference in the ſizes of two ovens that will fit one within the other need not be very conſiderable.—But I forget that I am writing for theervereſt and moſt experienced workmen upon the face of the earth, to whom the utility of theſe contrivances is perfectly familiar, and who, without waiting for my ſuggeſtions, will not fail to put them all in practice.

Though there is nothing I am more anxious to avoid than tiring my reader with uſeleſs repetitions, yet I cannot help mentioning once more the great importance of cauſing the ſmōke that heats one of the ovens I have been deſcribing, to deſcend at leaſt as low as the level of the bottom of the oven, after it has paſſed round and over it, before it is permitted to riſe up freely and eſcape by the chimney into the atmoſphere. In ſetting the oven, and forming the canal for carrying off the ſmoke from the oven into the chimney, this may eaſily be effected; and if it be done, the oven will retain its heat for a great length of time even after the fire is gone out;—but if it be not done, the fire muſt conſtantly be kept up, or the oven will ſoon be cooled by the cold air that will not fail to force its way through the Fire-place and up the chimney.

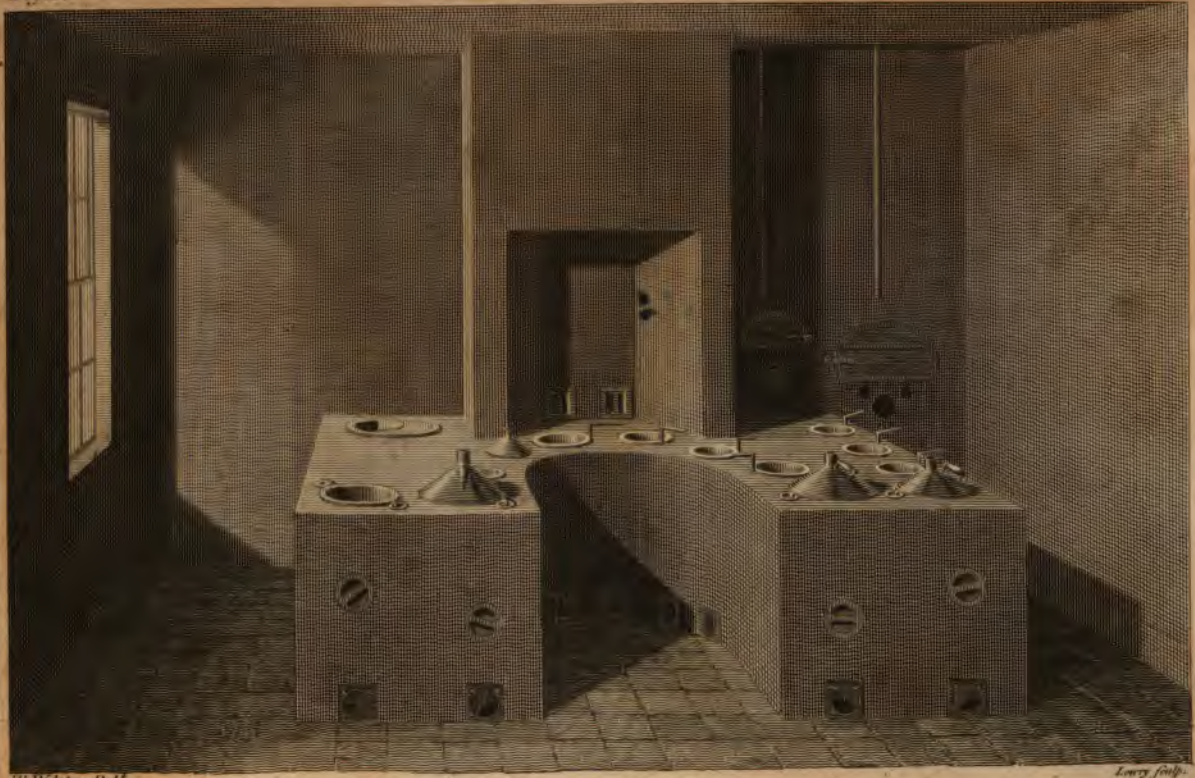
From the reſult of this experiment it appears, that an oven of the kind recommended is very far from being an expenſive article; and there is no doubt but that, with a little care in the management of the fire, an oven of this ſort would laſt many years without wanting any repairs. It is hardly neceſſary for me to add, that a neſt of theſe ſmall ovens, conſiſting of three or four, put up together, and heated by a ſingle fire, would be very uſeful in the kitchen of a private gentleman, and indeed of every large family.

If neſts of ſmall ovens ſhould come into uſe, (which I cannot help thinking will be the caſe,) it would be beſt, as well for convenience in carriage as for other reaſons, to make thoſe which belong to the ſame neſt, not preciſely of the ſame dimenſions, but varying in ſize juſt ſo much as ſhall be neceſſary, in order that they may be packed one within the other.

❧

Fig. 1.

Pl. I.



T. Webster Del.t

Lowry sculp.

Perspective View of the Kitchen of Baron de Lerchenfeld at Munich.

Plate II.

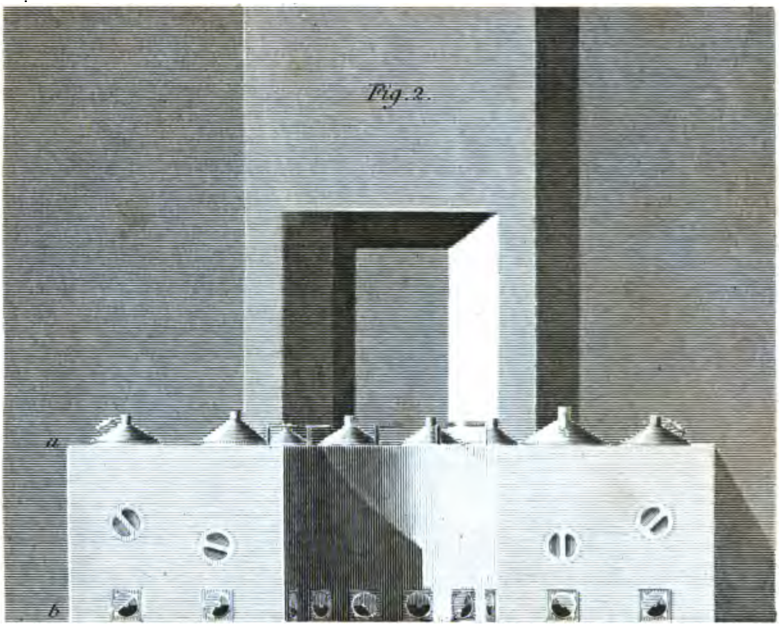


Fig. 2.

Plans of Baron de Lerchenfeld's Kitchen.

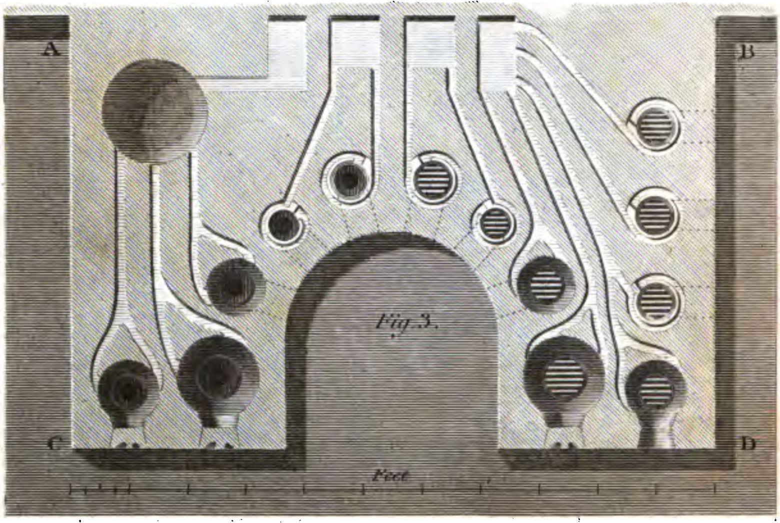


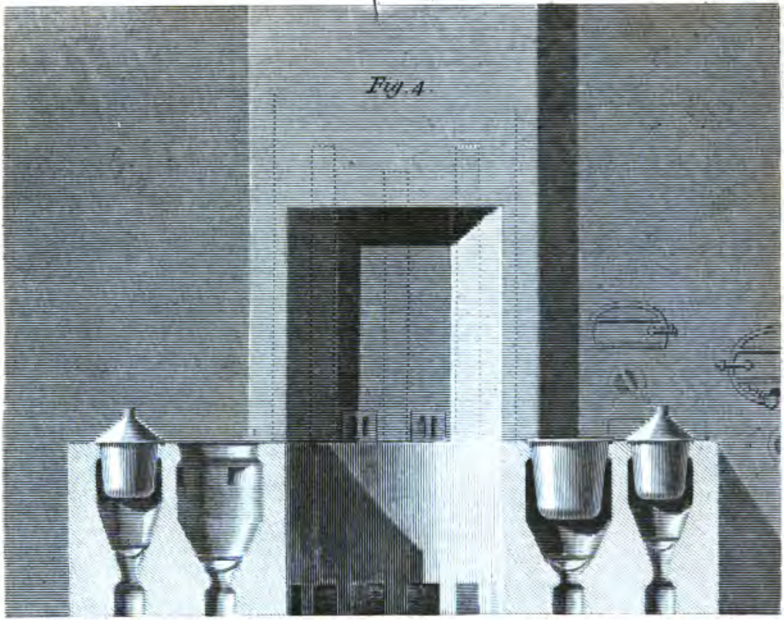
Fig. 3.

Lowry sculp.

UNIV. OF MICH.

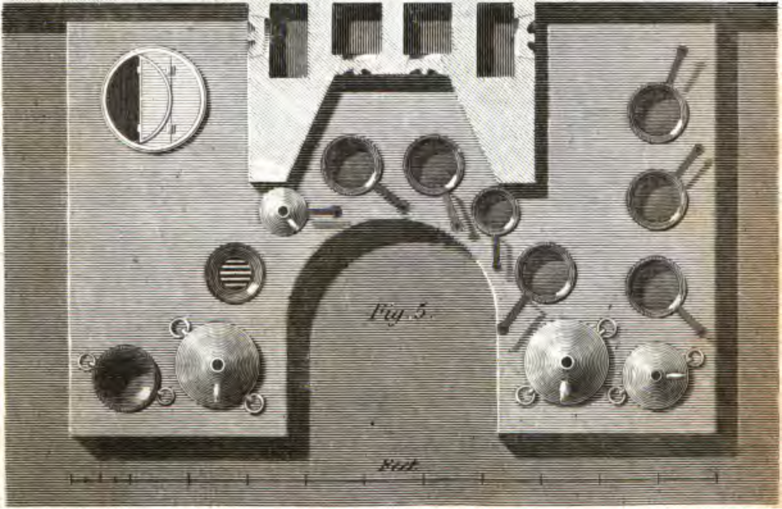
Plate III.

Fig. 4.



Plans of Baron de Lerchenfelds Kitchen.

Fig. 5.



Lowry sculp.

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Kitchen of the Hospital of La Pieta at Verona.

Plate IV.

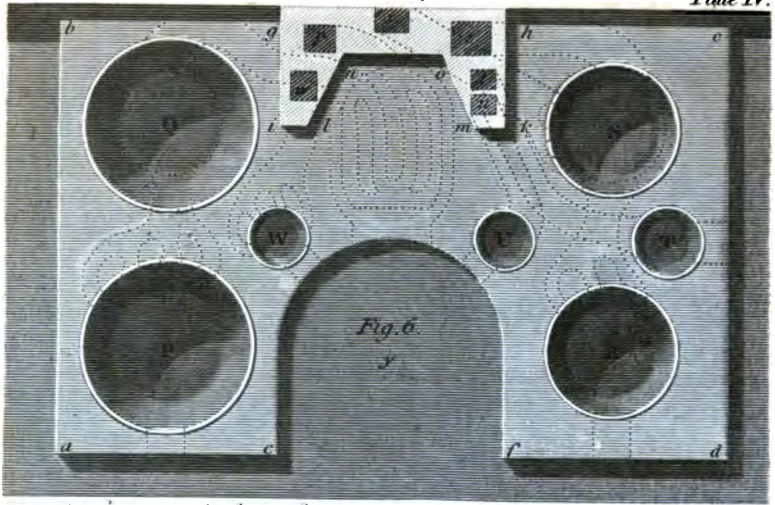
Fig. 6.

Kitchen of the House of Correction at Munich.

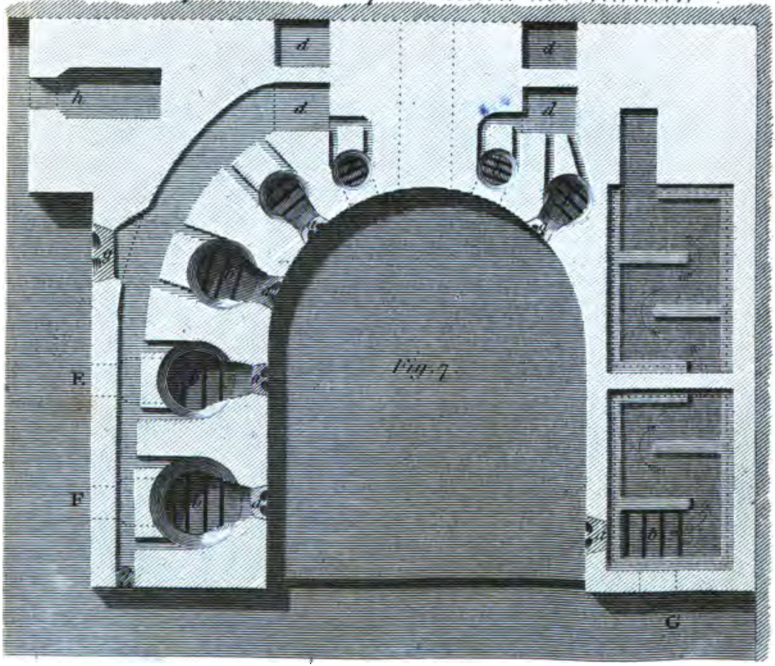
Fig. 7.

Scale 40 Inches to the Inch.

Lowry sculp.

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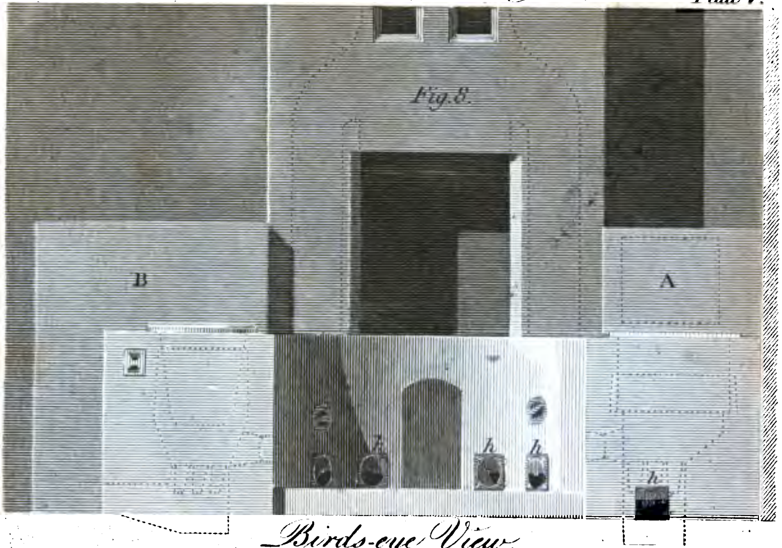
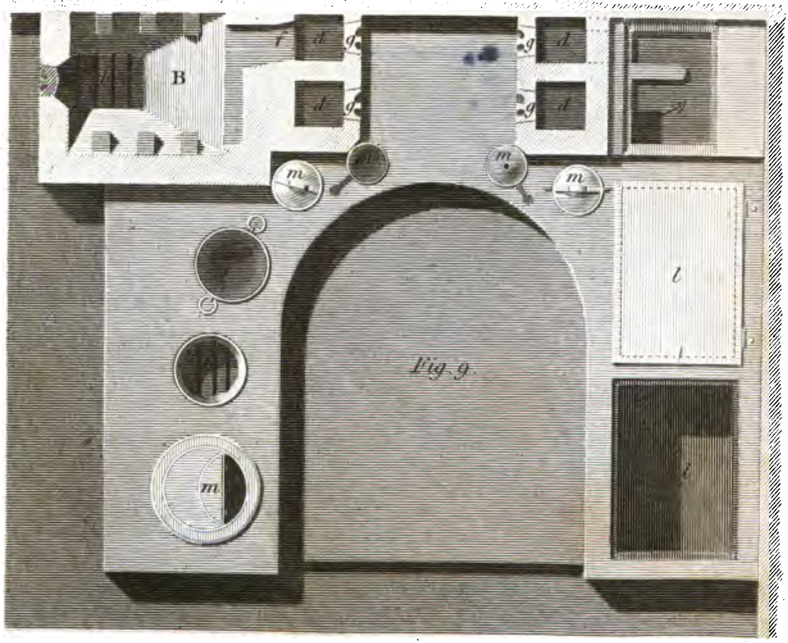
Front View of the Kitchen of the House of Correction at Munich.

Plate V.

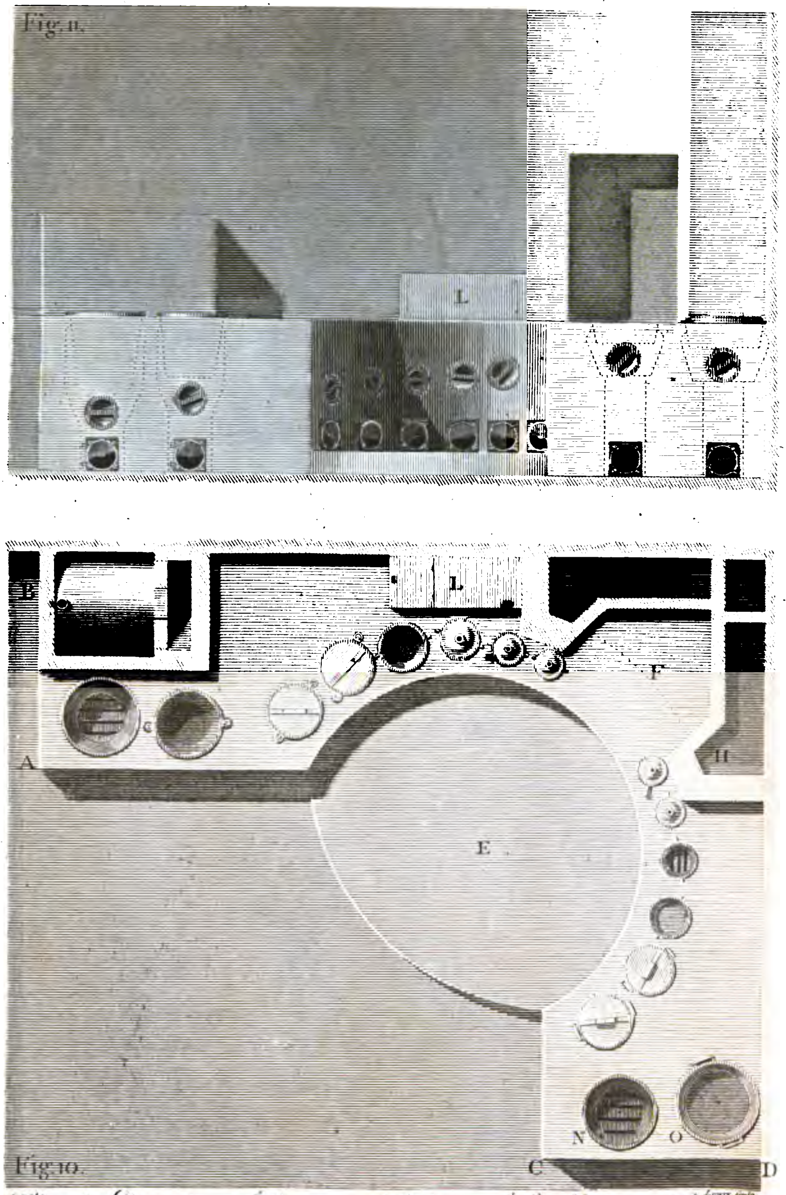


Birds-eye View.



Scale 40 Inches to the Inch.

Lowry sculp.



Lowry sculp.

Plan & Elevation of the new Kitchen of the Military Hospital at Munich.

UNIV. OF MICH.

Plan of a Part of the Kitchen of the Military Academy. Pl. VII

Fig. 13.

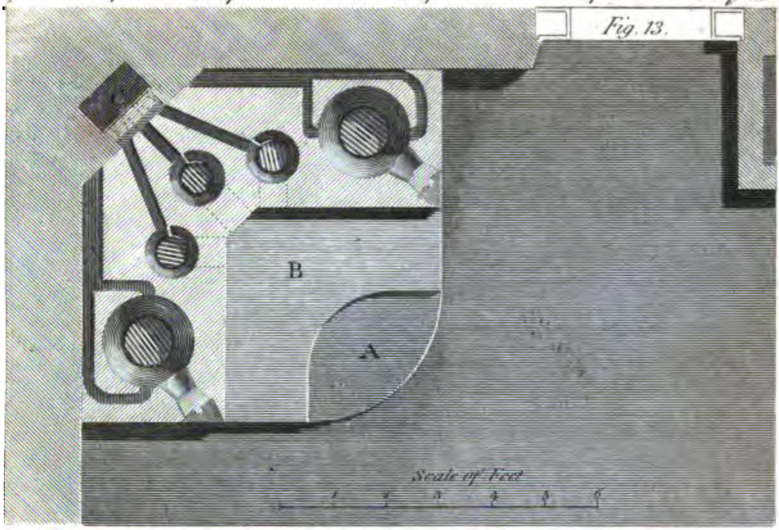
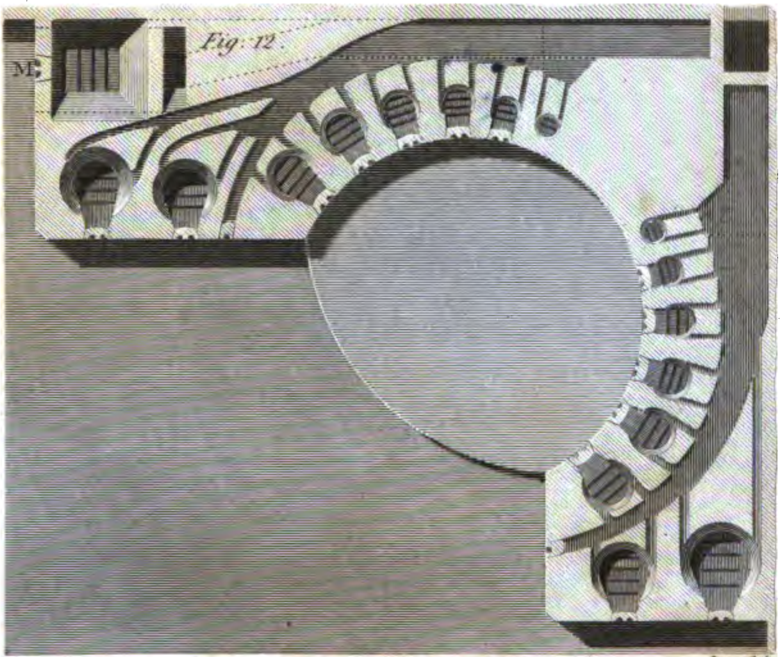


Fig: 12.



Plan of the New Kitchen of the Military Hospital at Munich.

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ESSAY X.

PART II.

ON THE

CONSTRUCTION OF KITCHEN FIRE-PLACES

AND

KITCHEN UTENSILS;

TOGETHER WITH

REMARKS AND OBSERVATIONS

RELATING TO THE VARIOUS

PROCESSES OF COOKERY;

AND

PROPOSALS FOR IMPROVING

THAT MOST USEFUL ART.

PREFACE.

I TOO often find myſelf in ſituations, in which I feel it to be neceſſary to make apologies for delays and irregularities in the publication of my writings. This Second Part of my Tenth Eſſay was announced in the beginning of the year 1800; and it ought certainly to have made its appearance long ago; but a variety of circumſtances have conſpired to retard its publication.

During ſeveral months, almoſt the whole of my time was taken up with the buſineſs of the ROYAL INSTITUTION; and thoſe who are acquainted with the nature and objects of that noble eſtabliſhment, will, no doubt, think that I judged wiſely, in preferring its intereſts to every other concern. For my own part, I certainly conſider it as being by far the moſt uſeful, and conſequently the moſt important undertaking in which I was ever engaged, and of courſe I feel deeply intereſted in its ſucceſs. The diſtinguiſhed patronage, and liberal ſupport, it has already received, afford good ground to hope that it will continue to proſper, and be a laſting monument of the liberality and enterprizing ſpirit of an enlightened nation.

It is certainly a proud circumſtance for this country, that, in times, like the preſent, and under the accumulated preſſure of a long and expenſive war, individuals generouſly came forward, and ſubſcribed, in a very ſhort time, no leſs a ſum than *thirty thouſand pounds ſterling*, for the noble purpoſe of "DIFFUSING THE KNOWLEDGE AND "FACILITATING THE GENERAL INTRODUCTION OF NEW AND USEFUL INVENTIONS "AND IMPROVEMENTS."

In the *repoſitory* of this new eſtabliſhment, will be found, Specimens of all the Mechanical Improvements which I have ventured to recommend to the Public in my Eſſays.

ESSAY X.—PART II.

CHAP. IV.

An Account of a new Contrivance for roaſting meat.—Circumſtance which gave riſe to this invention.—Means uſed for introducing it into common uſe.—Liſt of tradeſmen who manufacture Roaſters.—Number of them that have already been ſold.—Deſcription of the Roaſter.—Explanation of its action.—Reaſons why meat roaſted in this machine is better taſted and more wholeſome than when roaſted on a ſpit.—It is not only better taſted, but alſo more in quantity when cooked.—Directions for ſetting Roaſters in brick-work.—Directions for the management of a Roaſter.—Miſcellaneous obſervations reſpecting Roaſters and ovens.

THERE is no proceſs of cookery more troubleſome to the cook, or attended with a greater waſte of fuel, than roaſting meat before an open fire.

Having had occaſion, ſeveral years ago, to fit up a large kitchen (that belonging to the Military Academy at Munich) in which it was neceſſary to make arrangements for roaſting meat every day for near 200 perſons, I was led to conſider this ſubject with ſome attention; and I availed myſelf of the opportunity which then offered, to make a number of intereſting experiments; from the reſults of which, I was enabled to conſtruct a machine for Roaſting, which upon trial was found to anſwer ſo well, that I thought it deſerving of being made known to the Public: accordingly, during the viſit I made to this country in the years 1795 and 1796, I cauſed two of theſe Roaſters to be conſtructed in London—one, at the houſe then occupied by the BOARD OF AGRICULTURE, and the other, at the FOUNDLING HOSPITAL; and a third was put up, under my direction, in Dublin, at the houſe of the DUBLIN SOCIETY.

All theſe were found to anſwer very well, and they were often imitated; but I had the mortification to find, on my return to England in the year 1798, that ſome miſtakes had been made in the conſtruction, and many in the management of them. Their fire-places had almoſt univerſally been made three or four times as large as they ought to have been; as, neither the cooks, nor the bricklayers who were employed in ſetting them, could be perſuaded that it was poſſible that any thing could be ſufficiently roaſted with a fire, which to them appeared to be *ridiculouſly ſmall*; and the large quantities of fuel which was introduced into theſe capacious fire-places, not only deſtroyed the machinery very ſoon, but, what was ſtill more fatal to the reputation of the contrivance, rendered it impoſſible for the meat to be well roaſted.

When meat, ſurrounded by air, is expoſed to the action of very intenſe heat, its ſurface is ſoon ſcorched and dried; which, preventing the meat from penetrating freely to the center of the piece, the meat cannot poſſibly be equally roaſted throughout.

Theſe miſtakes could not fail to diſcredit the invention, and retard its introduction into general uſe; but, being convinced, by long experience, of the utility of the contrivance, as well as by the unanimous opinion, in its favour, of all thoſe who had given it a fair trial, I was reſolved to perſiſt in my endeavours to make it known, and, if poſſible, to bring it into uſe in this country. The Roaſter, in the kitchen of the Military Academy at Munich, had been in daily uſe more than eight years; and many others in imitation of it, which had been put up in private families in Bavaria, and other parts of Germany, and in Switzerland, had been found to anſwer perfectly well; and as that in the kitchen of the Foundling Hoſpital, in London, had likewiſe, during the experience of two years, been found to perform, to the entire ſatisfaction of thoſe who have the direction of that noble Inſtitution, I was juſtified in concluding, that, wherever the experiment had failed, it muſt have been owing to miſmanagement. And I was the more anxious to get this contrivance brought into general uſe, as I was perfectly convinced, that meat roaſted by this new proceſs, is not merely as good, but *decidedly better*, that is to ſay, more delicate, more juicy, more ſavory, and higher flavoured, than when roaſted in the common way—on a ſpit, before an open fire.

A real improvement in the art of cookery, which unites the advantage of economy with wholeſomeneſs, and an increaſe of enjoyment in eating, appeared to me to be very intereſting; and I attended to the ſubject with all that zeal and perſeverance which a conviction of its importance naturally inſpired.

On my return to this country, in the autumn of the year 1798, one of the firſt things I undertook in the proſecution of my favourite purſuit, was to engage an ingenious tradeſman, who lives in a part of the town which is much frequented (Mr. Summers, ironmonger, of New Bond-ſtreet) to put up a Roaſter in his own kitchen;—to inſtruct his cook in the management of it;—to make daily uſe of it; to ſhew it in actual uſe to his cuſtomers, and others who might deſire to ſee it; and alſo to allow other cooks to be preſent, and aſſiſt when meat was roaſted in it, in order to their being convinced of its utility, and taught how to manage it. I likewiſe prevailed on him to engage an intelligent bricklayer in his ſervice, who would ſubmit to be taught to ſet Roaſters properly; and who would follow, *without deviation*, the directions he ſhould receive. All theſe arrangements were carried into execution in the beginning of the year 1799; and ſince that time Mr. Summers has ſold, and put up, no leſs than 260 Roaſters, all of which have been found to anſwer perfectly well; and although he employs a great many hands in the manufacture of this new article, he is not able to ſatiſfy all the demands of his numerous cuſtomers.

Many of theſe Roaſters have been put up in the houſes of perſons of the higheſt rank and diſtinction; others in the kitchens of artificers and tradeſmen; and others, again, in ſchools, taverns, and other houſes of public reſort; and in all theſe different ſituations, the uſe of them has been found to be economical, and advantageous in all reſpects.

Several other tradeſmen in London have alſo been engaged in the manufacture of Roaſters. Mr. Hopkins, of Greek-ſtreet, Soho, ironmonger to the King, made that which is at the Foundling hoſpital, likewiſe that which was put up in the houſe formerly occupied by the Board of Agriculture;—and he informs me, that he has ſold above 200 others, which have been put up in the kitchens of various hoſpitals and private families, in the capital, and in different parts of the country.

Meſſrs. Moffat and Co. of Great Queen-ſtreet, Lincoln's-Inn Fields, and Mr. Feetham, of Oxford-ſtreet; as alſo Mr. Gregory, Mr. Spotſwood, Mr. Hanan, and Mr. Briadwood, in Edinburgh; have engaged in the manufacture of them. Other tradeſmen, no doubt, with whoſe names I am not acquainted, have manufactured them; and as there is no difficulty whatever in their conſtruction, and as all perſons are at full liberty to manufacture and ſell them, I hope ſoon to ſee theſe Roaſters become a common article of trade.

I have done all that was in my power to improve and to bring them forward into notice; and all my wiſhes reſpecting them will be accompliſhed, if they ſhould be found to be uſeful; and if the public is furniſhed with them at reaſonable prices.

Several Roaſters, conſtructed by different workmen, may be ſeen, ſome of them ſet in brick-work, and others not, at the Repoſitory of the Royal Inſtitution.

I have delayed thus long to publiſh a deſcription of this contrivance, in order that its uſefulneſs might previouſly be eſtabliſhed by experience; and alſo, that I might be able, with the deſcription, to give notice to the public where the thing deſcribed might be ſeen. I was likewiſe deſirous of being able at the ſame time, to point out *ſeveral places* where the article might be had.

Theſe objects having been fully accompliſhed, I ſhall now proceed by giving

An Account of the ROASTER, *and of the Principles on which it is conſtructed.*

WHEN I firſt ſet about to contrive this machine, meditating on the nature of the mechanical and chemical operations that take place in the culinary proceſs in queſtion, it appeared to me that there could not poſſibly be any thing more neceſſary to the roaſting of meat than *heat*, in certain degrees of intenſity, accompanied by certain degrees of *dryneſs*;

dryneſs; and I thought, if matters could be ſo arranged, by means of ſimple mechanical contrivances, that the cook ſhould be enabled, not only to regulate the degrees of heat at pleaſure, but alſo *to combine* any given degree of *heat* with any degree of *moiſture*, or of *dryneſs* required; this would unqueſtionably put it in his power to perform every proceſs of *roaſting* in the higheſt poſſible perfection.

The means I uſed for attaining theſe ends, will appear by the following deſcription of the machinery I cauſed to be conſtructed for that purpoſe.

The moſt eſſential part of this machinery which I ſhall call the *body* of the Roaſter (ſee fig. 14.) is an hollow cylinder of ſheet-iron, which, for a Roaſter of a moderate ſize, may be made about 18 inches in diameter, and 24 inches long; cloſed at one end, and ſet in an horizontal poſition in a maſs of brick-work, in ſuch a manner that the flame of a ſmall fire, which is made in a cloſed fire-place directly under it, may play all round it, and heat it equally and expeditiouſly. The open end of this cylinder, which ſhould be even with the front of the brick-work in which it is ſet, is cloſed either with a double door of ſheet-iron, or with a ſingle door of ſheet-iron covered on the outſide with a pannel of wood; and in the cylinder there is an horizontal ſhelf, made of a flat plate of ſheet-iron, which is ſupported on ledges rivetted to the inſide of the cylinder, on each ſide of it. This ſhelf is ſituated about three inches below the center or level of the axis of the body of the Roaſter, and it ſerves as a ſupport for a dripping-pan, in which, or rather *over which* the meat to be roaſted is placed.

This dripping-pan, which is made of ſheet-iron, is about two inches deep, 16 inches wide above, 15½ inches in width below, and 22 inches long; and it is placed on four ſhort feet; or what is better, on two long ſliders, bent upwards at their two extremities, and faſtened to the ends of the dripping-pan, forming, together with the dripping-pan, a kind of ſledge; the bottom of the dripping-pan being raiſed by theſe means about an inch above the horizontal ſhelf on which it is ſupported.

In order that the dripping-pan on being puſhed into or drawn out of the Roaſter may be made to preſerve its direction, two ſtrait grooves are made in the ſhelf on which it is ſupported, which, receiving the ſliders of the dripping-pan, prevent it from ſlipping about from ſide to ſide, and ſtriking againſt the ſides of the Roaſter. The front ends of theſe grooves are ſeen in figure 14, as are alſo the front ends of the ſliders of the dripping-pan, and one of its handles.

In the dripping-pan, a gridiron (ſeen in fig. 14.) is placed, the horizontal bars of which are on a level with the ſides or brim of the dripping-pan, and on this gridiron the meat to be roaſted is laid; care being taken that there be always a ſufficient quantity of water in the dripping-pan to cover the whole of its bottom to the height of at leaſt half or three quarters of an inch.

This water is eſſential to the ſucceſs of the proceſs of roaſting: it is deſigned for receiving the drippings from the meat, and preventing their falling on the heated bottom of the dripping-pan, where they would be evaporated, and their oily parts burnt or volatilized, filling the Roaſter with ill-ſcented vapours which would ſpoil the meat, by giving it a diſagreeable taſte and ſmell.

It was with a view more effectually to defend the bottom of the dripping-pan from the fire, and prevent as much as poſſible the evaporation of the water it contains, that the dripping-pan was raiſed on feet or ſliders, inſtead of being merely ſet down on its bottom on the ſhelf which ſupports it in the Roaſter.

A late improvement has been made in the arrangement of the dripping-pan, by an ingenious workman at Norwich, Mr. Froſt, who has been employed in putting up Roaſters in that part of the country; an invention which I think will, in many caſes, if not in all, be found very uſeful. Having put a certain quantity of water into the principal dripping-pan, which is conſtructed of ſheet-iron, he places a ſecond, ſhallower, made of tin, and ſtanding on four ſhort feet, into the firſt, and then places the gridiron which is to ſupport the meat in this ſecond dripping pan. As the water in the firſt keeps the ſecond cool, there is no neceſſity for putting water into this; and the drippings of the meat may, without danger, be ſuffered to fall into it, and to remain there unmixed with water. When Yorkſhire puddings, or potatoes, are cooked under roaſting meat, this arrangement will be found very convenient.

In conſtructing the dripping-pans, and fitting them to each other, care muſt be taken that the ſecond do not touch the firſt, except by the ends of its feet; and eſpecially that the bottom of the ſecond (which may be made diſhing) do not touch the bottom of the firſt. The lengths and widths of the two dripping-pans above, or at their brims, may be equal, and the brim of the ſecond may ſtand about half an inch above the level of the brim of the firſt. The horizontal level of the upper ſurface of the gridiron ſhould not be lower than the level of the brim of the ſecond dripping-pan; and the meat ſhould be ſo placed on the gridiron that the drippings from it cannot fail to fall into the dripping-pan, and never upon the hot bottom or ſides of the Roaſter.

To carry off the ſteam which ariſes from the water in the dripping-pan, and that which eſcapes from the meat in roaſting, there is a ſteam-tube belonging to the Roaſter, which is ſituated at the upper part of the Roaſter, commonly a little on one ſide, and near the front of it, to which tube there is a damper, which is ſo contrived as to be eaſily regulated without opening the door of the

Roaſter. This ſteam-tube is diſtinctly ſeen in figure 14; and the end of the handle by which its damper is moved, may be ſeen in figure 15.

The heat of the Roaſter is regulated at pleaſure, and to the greateſt nicety, by means of the regiſter in the aſh-pit door of its fire-place (repreſented in figure 15.) and by the damper in the canal, by which the ſmoke goes off into the chimney; which damper is not repreſented in any of the figures.

The *dryneſs* in the Roaſter is regulated by the damper of the ſteam-tube, and alſo by means of a very eſſential part of the apparatus—the *blow-pipes*—which ſtill remain to be deſcribed. They are diſtinctly repreſented in the figures 14, 15, and 16.

Theſe blow-pipes, which lie immediately under the Roaſter, are two tubes of iron, about 2½ inches in diameter, and 23 inches long, or about one inch ſhorter than the Roaſter; which tubes, by means of elbows at their farther ends, are firmly fixed to the bottom of the Roaſter, and communicate with the inſide of it. The hither ends of theſe tubes come through the brick-work, and are ſeen in front of the Roaſter, being even with its face.

Theſe blow-pipes have ſtoppers, by which they are accurately cloſed; but when the meat is to be *browned*, theſe ſtoppers are removed, or drawn out a little, and the damper in the ſteam-tube of the Roaſter being at the ſame time opened, a ſtrong current of hot air preſſes in through the tubes into the Roaſter, and through the Roaſter into and through the ſteam-tube, carrying and driving away all the moiſt air and vapour out of the Roaſter.

As theſe blow-pipes are ſituated immediately below the Roaſter, and juſt over the fire, and are ſurrounded on every ſide by the flame of the burning fuel (ſee figure 16.) they are much expoſed to the heat; and when the fire is made to burn briſkly, which ſhould always be done when the meat is to be browned, they will be heated red-hot, conſequently the air which paſſes through them into the Roaſter will be much heated; and this *hot wind* which blows over the meat, will ſuddenly heat and dry its ſurface in every part, and give it that appearance and taſte which are peculiar to meat that is well roaſted.

When theſe Roaſters were firſt propoſed, and before their merit was eſtabliſhed, many doubts were entertained reſpecting the taſte of the food prepared in them. As the meat was ſhut up in a confined ſpace, which has much the appearance of an oven, it was natural enough to ſuſpect that it would be rather *baked* than *roaſted*; but all thoſe who have tried the experiment have found that this is by no means the caſe. The meat is *roaſted*, and not *baked*; and however bold the aſſertion may appear, I will venture to affirm, that meat of every kind, without any exception, roaſted in a roaſter, is *better taſted—higher flavoured—and much* *more juicy and delicate,* than when roaſted on a ſpit before an open fire.

I ſhould not have dared to have publiſhed this opinion four years ago; but I can with ſafety do it now, for I can appeal for a confirmation of the fact to the reſults of a number of deciſive experiments, lately made in this metropolis, and by the moſt *competent judges.*

Among many others who, during the laſt year, have cauſed Roaſters to be put up in their kitchens, I could mention one perſon in particular, a nobleman, diſtinguiſhed as much by his ingenuity and indefatigable zeal in promoting uſeful improvements, as by his urbanity and his knowledge in the art of refined cookery; who had *two Roaſters* put in his houſe in town, and who informs me, that he has frequently invited company to dine with him ſince his Roaſters have been in uſe, and that the diſhes prepared in them have never failed to meet with marked approbation.

In enumerating the excellencies of this new implement of cookery, there is one of indiſputable importance, which ought not to be omitted. When meat is roaſted in this machine, its *quantity,* determined by weight, is conſiderably greater than if it were roaſted upon a ſpit before a fire. To aſcertain this fact, two legs of mutton, taken from the ſame carcaſe, and made perfectly equal in weight before they were cooked, were roaſted on the ſame day, the one in a Roaſter, the other on a ſpit before the fire; and to prevent all deception, the perſons employed in roaſting them were not informed of the principal deſign of the experiment. When theſe pieces of roaſted meat came from the fire, they were carefully weighed; when it appeared, that the piece which had been roaſted in the Roaſter was heavier than the other, by a difference which was equal to ſix *per Cent.* or ſix pounds in an hundred. But this even is not all; nor is it indeed the moſt important reſult of the experiment. Theſe two legs of mutton were brought upon table at the ſame time, and a large and perfectly unprejudiced company was aſſembled to eat them. They were both declared to be very good; but a decided preference was unanimouſly given to that which had been roaſted in the Roaſter, it was much more juicy, and was thought better taſted. They were both fairly eaten up; nothing remaining of either of them that was eatable. Their fragments, which had been carefully preſerved, being now collected and placed in their ſeparate diſhes; it was *a compariſon of theſe fragments* which afforded the moſt ſtriking proof of the relative merit of theſe two methods of roaſting meat, in reſpect to the economy of food. Of the leg of mutton which had been roaſted in the Roaſter, hardly any thing viſible remained except the bare bone; while a conſiderable heap was formed of ſcraps not eatable, which remained of that roaſted on a ſpit.

I believe I may venture to ſay, that the reſult of this experiment is deſerving of the moſt ſerious attention, eſpecially in this country, where ſo much roaſted meat is eaten, and where the economy of food is every day growing to be more and more an object of public concern.

I could mention ſeveral other experiments ſimilar to that juſt deſcribed, which have been made, and with ſimilar reſults; but it would be ſuperfluous to bring many examples to aſcertain a fact, which is ſo well eſtabliſhed by one.

There is one peculiarity more, reſpecting meat roaſted in a Roaſter, which I muſt mention; that is, the uncommon delicacy of the taſte of the fat of the meat ſo roaſted, eſpecially when it has been done by *a very ſlow fire.* When good mutton is roaſted in this manner, its fat is exquiſitely ſweet and well taſted; and when eaten with currant jelly, can hardly be diſtinguiſhed from the fat of the very beſt veniſon. The fat parts of other kinds of meat are alſo uncommonly delicate when prepared in this manner; and there is reaſon to think that they are much leſs unwholeſome than when they are roaſted before an open fire.

The heat which is generated by the rays which proceed from burning fuel, is frequently moſt intenſe; and hence it is that the ſurface of a piece of meat that is roaſted on a ſpit, is often quite burnt, and rendered not only hard and ill-taſted, but very unwholeſome. The fat of veniſon is not thought to be unwholeſome; but in roaſting veniſon, care is taken by covering it, to prevent the rays from the fire from burning it. In the Roaſting

ing machine, the bad effects of theſe direct rays are always prevented by the ſides of the Roaſter, which intercepts them, and protects the ſurface of the meat from the exceſſive violence of their action; and even, when at the end of the proceſs of roaſting, the intenſity of the heat in the Roaſter is ſo far increaſed as to brown the ſurface of the meat, yet this heat being communicated through the medium of a heated fluid (air) is much more moderate and uniform and certain in its effects, than direct rays which proceed from burning fuel, or from bodies heated to a ſtate of incandeſcence.

Directions for SETTING *Roaſters.*

THERE are two points, to which attention muſt be paid by bricklayers in SETTING theſe Roaſters; otherwiſe they will not be found to anſwer. Their fire-places muſt be made extremely ſmall; and proviſion muſt be made for cleaning out their flues from time to time when they become obſtructed with ſoot.

When I firſt introduced theſe Roaſters into this country five years ago, I was not fully aware of the irreſiſtible propenſity to make too great fires on all occaſions, which thoſe people have who inhabit kitchens; but ſad experience has ſince taught me, that nothing ſhort of rendering it abſolutely impoſſible to deſtroy my Roaſters by fire, will prevent their being ſo deſtroyed. The knowledge of this fact has put me on my guard, and I now take effectual meaſures for preventing this evil. I cauſe the fire-places of Roaſters to be made *very ſmall*, and direct them to be ſituated at a conſiderable diſtance below the bottom of the Roaſter.

For a Roaſter which is 18 inches wide, and 24 inches long, the fire-place ſhould not be more than ſeven inches wide and nine inches long; and the ſide walls of the fire-place ſhould be quite vertical to the height of ſix or ſeven inches. Small as this fire-place may appear to be, it will contain quite coals enough to heat the Roaſter, and many more than will be found neceſſary for keeping it hot when heated. The fact is, that the quantity of fuel required to roaſt meat in this way, is almoſt incredibly ſmall. By experiments, made with great care at the Foundling Hoſpital, it appeared to be only about *one ſixteenth* part of the quantity which would be required to roaſt the ſame quantity of meat in the common way before an open fire. But it is not merely to ſave fuel that I recommend the fire-places to be made very ſmall;—it is to prevent the Roaſters from being wantonly deſtroyed, the meat ſpoiled, and a uſeful invention diſcredited.

With regard to the proviſion which ought to be made, in the ſetting of a Roaſter, for occaſionally cleaning out its flues, this muſt be done by leaving proper openings (about four or five inches ſquare for inſtance) in the brick-work, to introduce a bruſh, like a bottle-bruſh, with a long handle; which openings may be cloſed with ſtoppers or fit pieces of brick, or of ſtone, and the joinings made good with a little moiſt clay, To render theſe ſtoppers more conſpicuous, they may each be furniſhed with a ſmall iron ring or knob, which will likewiſe be uſeful as an handle in removing them, and replacing them.

In the figures of 15 and 16, a ſimple cōntrivance may be ſeen, repreſented, by means of which the ſoot which is apt to collect about the top of a Roaſter, may be removed with very little trouble as often as it ſhall be found neceſſary, without injuring the brick-work, or deranging any part of the machinery. By means of an oblong ſquare frame, conſtructed of ſheet iron, and faſtened to the top of the Roaſter by rivets, a door-way is opened into the void ſpace left for the flame and ſmoke between the outſide of the Roaſter, and the hollow arch or vault in which it is placed; and by introducing a bruſh with a flexible handle through this door-way, the ſoot adhering to the outſide of the top of the Roaſter, and to the ſurface of the brick-work ſurrounding it, may be detached and made to fall back into the fire-place, from whence it may be removed with a ſhovel. The ſides of the Roaſter may be cleaned by introducing a bruſh through the door-way of the fire-place.

The door-way at the top of the Roaſter may be cloſed either by a ſtopper made of ſheet iron, or by a fit piece of ſtone or brick, furniſhed with a ring or knob, to ſerve as a handle to it.

If coke be burnt under theſe Roaſters, inſtead of coal (which, as they will not be more expenſive fuel, and as they burn longer, and give a more equal heat, I would ſtrongly recommend) the flues will ſeldom if ever require to be cleaned out. I burn nothing but coke and a few pieces of wood, in the cloſed fire-places of my own kitchen; and for my open chimney fires, I uſe a mixture of coke and coals, which makes a very pleaſant fire, and is, I believe, leſs expenſive than coals. It appears to me that there is no ſubject which offers ſo promiſing a field for experimental inveſtigation, and where uſeful improvements would be ſo likely to be made, as in the *combination and preparation of fuel.*—But to return from this digreſſion.

In conſtructing the fire-place of a Roaſter (and all other cloſed fire-places) care muſt be taken to place the iron-bars on which the fuel burns, at a conſiderable diſtance from the door of the fire-place; otherwiſe this door being near the fire, its handle will become very hot, and it will burn the hand of a perſon that takes hold of it. I have more than once ſeen Roaſters and ovens condemned, diſgraced, and totally neglected, merely from an accident of this kind. And yet how eaſy would it have been to have corrected this fault! —If the door of the fire-place is formed to become too hot, ſend for the bricklayer, and let him put the fire-place farther backward.

There ſhould always be a paſſage, or throat, of a certain length, between the mouth or door of a cloſed fire-place, and the fire-place properly ſo called, or the cavity occupied by the burning fuel. Where fire-places are of large dimenſions, it is very uſeful (as indeed it is cuſtomary) to keep this throat conſtantly filled and choaked up with coal. This coal, which, as there is no ſupply of air in the paſſage, does not burn, ſerves to defend the fire-place door from the heat of the fire. It ſerves another uſeful purpoſe; it gets well warmed, and even heated very hot before it is puſhed forward into the fire-place, which diſpoſes it to take fire inſtantaneouſly, and without cooling the fire-place and depreſſing the fire when it is introduced. If any part of it takes fire while it occupies the throat or paſſage of the fire-place, it is that part only which is in immediate contact with the burning fuel; and what is ſo burnt, is conſumed under the moſt advantageous circumſtances; for the thick vapour which riſes from this coal, as it grows very hot, and which, under other leſs favourable circumſtances, would not fail to go off in ſmoke, takes fire in paſſing over the burning fuel, and burns with a clear bright flame. I have had frequent opportunities of verifying this intereſting fact; and I mention it now, in order, if poſſible, to fix the attention of thoſe who have the management of large fires, to an object which perhaps is of greater importance than they are aware of.

When good reaſons can be aſſigned for the advantages which reſult from any common practice, this not only tends to ſatisfy the mind, and make people careful, cheerful, and attentive in the proſecution of their buſineſs, but it has alſo a very ſalutary influence, by preventing thoſe perpetual variations and idle attempts at improvement, *undirected by ſcience*, which are the conſequence of the inconſtancy, curioſity, and reſtleſsneſs of man.

Diſcoveries are always accidental; and the great uſe of *ſcience* is by inveſtigating the nature of the effects produced by any proceſs or contrivance, and of the cauſes by which they are brought about, to explain the operation, and determine the preciſe value of every new invention. This fixes as it were the *latitude* and *longitude* of each diſcovery, and enables us to place it in that part of the map of human knowledge which it ought to occupy It likewiſe enables us to uſe it in taking *bearings* and *diſtances*, and in ſhaping our courſe when we go in ſearch of new diſcoveries.—But I am again ſtraying very far from my humble ſubject.

In conſtructing cloſed fire-places for Roaſters, Boilers, Ovens, &c. for kitchens, I have found it to be a good general rule to make the diſtance between the fire-place door and the hither end of the bars of the grate, juſt equal to the width of the fire-place, meaſured juſt above the bars. In fire-places of a moderate ſize, where double doors are uſed, it will ſuffice, if the diſtance from the hinder ſide of the inner door, to the hither end of the bars, be made equal to the width of a brick, or 4½ inches; but if the door be not double, it is neceſſary that the length of the paſſage from the door, into the place occupied by the burning fuel, ſhould be at leaſt ſix or ſeven inches.

In ſetting the iron frame of the door of a cloſed fire-place, care ſhould be taken to maſk the metal by ſetting the bricks before it in ſuch a manner that no part of the frame *may be ſeen* (if I may uſe that expreſſion) by the fire. This precaution ſhould be uſed in conſtructing fire-places of all ſizes, otherwiſe the frame of the fire-place door will be heated very hot by the rays from the burning fuel, eſpecially when the fire-place is large, and its form will ſoon be deſtroyed by the frequent expanſion and contraction of the metal. The conſequences of this change of form will be, the looſening of the frame in the brick-work, and the admiſſion of air into the fire-place over the fire, between the ſides of the frame and the brick-work, and likewiſe between the frame and its door, which will no longer fit each other.

The expence of keeping large fire-places in repair is very conſiderable, as I have learnt from ſome of the London brewers. More than *nine-tenths* of that expence might eaſily be ſaved, by conſtructing the machinery more ſcientifically, and uſing it with care.

Fig. 15, is a front view; and fig. 16, repreſents a vertical ſection of a Roaſter, ſet in brick-work. The hollow ſpaces repreſented in fig. 16. are expreſſed by ſtrong vertical lines, namely, the aſh-pit, A. the fire-place, B. The ſpace between the outſide of the Roaſter, and the arch of brick-work which ſurrounds it, C.—the broad canal at the farther end of the Roaſter, by which the ſmoke deſcends, D.—and the place E, where it turns, in order to paſs upwards into the chimney by the perpendicular canal, F.—The brick-work is expreſſed by fainter lines drawn in the ſame direction.

The farther end of the Roaſter muſt be ſo fixed in the brick-work, that no part of the ſmoke can find its way from the fire-place B, directly into the canal D, otherwiſe it will not paſs up by the ſides of the Roaſter to the top of it. At the top of the Roaſter, at its farther end, an opening muſt of courſe be left for the ſmoke to paſs into the deſcending canal D.

As I have already mentioned the neceſſity of cauſing the ſmoke, which is uſed for heating an iron oven or a Roaſter, *to deſcend* before it is permitted to paſs off into the chimney, I ſhall inſiſt no farther on that important point in this place. It may, however, be uſeful to obſerve, that if the place where a Roaſter is ſet is not deep enough to allow of the deſcending canal, D, and the canal F, by which the ſmoke aſcends and paſſes into the chimney, to be ſituated at the farther end of the Roaſter, both theſe canals may, without the ſmalleſt inconvenience, be placed on one ſide of the Roaſter: indeed, as houſes are now built, it will commonly be moſt convenient to place them on one ſide, and not at the end of the Roaſter. When this is done, the ſmoke muſt be permitted to paſs up behind the farther end of the Roaſter, as well as by the ſides of it.

By taking away a large flat ſtone, or a twelve-inch tile, placed edgeways, a paſſage from A to E may be opened occaſionally, in order to clean out the canals D and F, and remove the ſoot. Theſe paſſages may be cleaned out either from above or from below, by means of a bruſh, with a long flexible handle.

The ſteam tube (which is ſeen in this figure) muſt open into a ſeparate canal (not expreſſed in the figure) which muſt be conſtructed for the ſole purpoſe of carrying off the ſteam into the chimney, or into the open air. If this ſteam tube were to open into either of the cavities or canals C, D, E, or F, in which the ſmoke from the fire which heats the Roaſter circulates, this ſmoke might, on ſome occaſions, be driven back into the Roaſter, which could not fail to give a bad taſte to the meat. The ſteam tube muſt be laid on a *deſcent*, otherwiſe the water generated in it, in conſequence of the condenſation of the ſteam, might run back into the Roaſter.

Some care will be neceſſary in forming the vault which is to cover the Roaſter above. Its form ſhould be regular, in order that it may be every where at the ſame diſtance from the Roaſter; and its concave ſurface ſhould be as even and ſmooth as poſſible, in order that there may be the fewer cavities for the lodgment of ſoot. The diſtance between the outſide of the Roaſter and the concave ſurface of this vault, may be about two inches; and the ſame diſtance may be preſerved below, between the brick-work and the ſides of the Roaſter. In the figure 15, the outline of the fire-place and of the cavity in which the Roaſter is ſet, is indicated by a dotted line.

Directions for the Management of a Roaſter.

Care muſt be taken to keep the Roaſter very clean, and above all, to prevent the meat from touching the ſides of it, and the gravy from being ſpilt on its bottom. If by any means it becomes greaſy in any part that is expoſed to the action of the fire, as the metal becomes hot, this greaſe will be evaporated, as has already been obſerved, and will fill the Roaſter with the moſt offenſive vapour. When greaſe ſpots appear, the inſide of the Roaſter muſt be waſhed, firſt with ſoap and water, to take away the greaſe, and then with pure water, to take away the ſoap, and it muſt then be wiped with a cloth till it be quite dry.

The fire muſt be moderate, and time muſt be allowed for the meat to be roaſted *by the moſt gentle heat.* About one-third more time ſhould in general be employed in roaſting meat in a Roaſter, than would be neceſſary to roaſt it in the uſual way, on a ſpit before a fire.

The blow-pipes ſhould be kept conſtantly cloſed from the time the meat goes into the Roaſter, till within 12 or 15 minutes of its being ſufficiently done to be ſent to the table, that is to ſay, till it is fit *to be browned.*

The meat is browned in the following manner: the fire is made to burn bright and clear for a few minutes, till the blow-pipes begin to be red-hot (which may be ſeen by withdrawing their ſtoppers for a moment, and looking into them;) when the damper of the ſteam-tube of the Roaſter being opened, and the ſtoppers of the blow-pipes drawn out, a certain quantity of air is permitted to paſs through the heated blow-pipes, into and through the Roaſter.

I ſay, *a certain quantity* of air is allowed to paſs through the blow-pipes into the Roaſter. If the ſteam-tube and the blow-pipes were ſet *wide open*, it is very poſſible, that too much might be admitted, and that the inſide of the Roaſter and its contents might be cooled by it, inſtead of being raiſed to a higher temperature. As the velocity with which the cold air of the atmoſphere will ruſh into and through the blow-pipes of a Roaſter will depend on a variety of circumſtances, and may be very different even in Roaſters of the ſame ſize and conſtruction, no general rules can be given in browning the meat for the regulation of the ſtoppers of the blow-pipes, and of the damper in the ſteam tube; theſe muſt depend on what may be called *the Trim of the Roaſter*, which will ſoon be diſcovered by the cook.

There is an infallible rule for the regulation of the damper of the ſteam tube, *during the time the meat is roaſting by a gentle heat.* It muſt then be kept juſt ſo much opened, that the ſteam which ariſes from the meat, and from the evaporation of the water in the dripping-pan, may not be ſeen coming out of the Roaſter through the crevices of its door; for if it be more opened, the cold air of the atmoſphere will ruſh into the Roaſter through thoſe crevices, and by partially cooling it, will derange the proceſs that is going on; and if it be leſs opened, the room will be filled with ſteam.

In brightening the fire, preparatory to the browning of the meat, the regiſter in the aſh-pit door, and the damper in the canal by which the ſmoke paſſes off into the chimney, ſhould both be opened, and it may be uſeful to ſtir up the fire with a poker, but this would be a very improper time for throwing a quantity of freſh coals into the fire-place, for that would cool the fire-place, and damp the fire for a conſiderable time. By far the beſt method of brightening the fire for this purpoſe, would be to throw a ſmall faggot into the fire, or a little bundle of dry wood of any kind, ſplit into ſmall pieces about ſix or ſeven inches in length. This would afford a clear bright flame, which would heat the blow-pipes quickly, and without injuring them. Indeed wood ought always to be uſed for heating Roaſters, in preference to coal, where it can be had, and the quantity of it required is ſo extremely ſmall, that the difference in the expence would be very trifling, even here in London, where the price of fire-wood is ſo high. And if the durability of the machinery be taken into the account, which is but juſt, I am confident, that for heating Roaſters and Ovens conſtructed of ſheet iron, coals would turn out to be dearer fuel than wood.

I have already inſiſted ſo much on the neceſſity of keeping a quantity of water under meat that is roaſting, in order to prevent the drippings from the meat from falling on any very hot metal, that I ſhall not now enlarge farther on the ſubject, except by ſaying, once more, that it is a circumſtance, to which it is indiſpenſably neceſſary to pay attention.

When meat is roaſted by a very moderate heat, it will ſeldom or never require being either turned or baſted, but when the heat in the Roaſter is more intenſe, it will be found uſeful both to turn it, and to baſte it three or four times during the proceſs. The reaſon of this difference in the manner of proceeding, will be evident to thoſe who conſider the matter with attention.

When Roaſters are conſtructed of large dimenſions, ſeveral kinds of meat may be roaſted in them at the ſame time. If care be taken to preſerve their drippings ſeparate, which may eaſily be done by placing under each a ſeparate diſh, or dripping-pan, ſtanding in water contained in a larger dripping-pan, there will be no mixture of taſtes; and, what no doubt will appear ſtill more extraordinary, a whole dinner, conſiſting of various diſhes, roaſted, ſtewed, baked, and boiled, may be prepared at the ſame time in the ſame Roaſter, without any mixture whatever of taſtes. A reſpectable friend of mine, who firſt made the experiment, and who has ſince repeated it ſeveral times, has aſſured me of this curious fact. It may perhaps, in time, turn out to be an important diſcovery. A ſimple and economical contrivance, by means of which all the different proceſſes of cookery could be carried on at the ſame time, and by one ſmall fire, would, no doubt, be a valuable acquiſition.

It is very certain that Roaſters will either bake or roaſt, ſeparately, in the higheſt poſſible perfection; and it is not improbable that, with certain precautions in the management of them, they may be made to perform thoſe two proceſſes at the ſame time, in ſuch a manner as to give general ſatisfaction. When Roaſters are deſigned for roaſting and baking at the ſame time, they ſhould be made ſufficiently large to admit of a ſhelf above the meat, on which the things to be baked ſhould be placed. I am told, that above half the Roaſters lately put up in London, are ſo conſtructed, and that they are frequently made to roaſt and bake at the ſame time. I ſhall take another opportunity of enlarging on the utility of this contrivance.

There is a precaution to be taken in opening the door of a Roaſter, when meat is roaſting in it, which ought never to be neglected; that is, to open the ſteam-tube and both the blow-pipes, for about a quarter of a minute, or while a perſon can count fifteen or twenty, before the door of the Roaſter be thrown open. This will drive away the ſteam and vapour out of the Roaſter, which otherwiſe would not fail to come into the room as often as the door of the Roaſter is opened.

As it will frequently happen that the meat will be done before it will be time to ſend it up to table; when this is the caſe, it may either be taken out of the Roaſter and put into a hot cloſet, which may very conveniently be ſituated immediately over the Roaſter, or it may remain in the Roaſter till it is wanted. If this laſt mentioned method of keeping it warm be adopted, the following precautions will be neceſſary for cooling the Roaſter, otherwiſe the proceſs of roaſting will ſtill go on, and the meat, inſtead of being merely kept warm, will be over done: The regiſter in the aſh-pit door ſhould be cloſed; the fire-place door, and the damper in the chimney, ſhould be ſet wide open; the fire ſhould either be taken out of the fire-place, or it ſhould be covered with cold aſhes; and laſtly, the damper in the ſteam-tube and both the blow-pipes ſhould be opened. By theſe means the heat will very ſoon be driven away up the chimney, and as ſoon as it is ſo far moderated as to be no longer dangerous, the blow-pipes and the damper in the ſteam-tube may be nearly cloſed; and if there ſhould be danger of the cooling being carried too far, the fire-place door may be ſhut. By theſe means the heat of the Roaſter, and of the brick-work which ſurrounds it, may be moderated and regulated at pleaſure, and meat already roaſted may be kept warm, for almoſt any length of time, without any danger of its being ſpoiled.

Miſcellaneous Obſervations reſpecting Roaſters and Ovens.

I SHALL, no doubt, be criticiſed by many, for dwelling ſo long on a ſubject, which to them will appear low, vulgar, and trifling; but I muſt not be deterred by faſtidious criticiſms from doing all I can do, to ſucceed in what I have undertaken. Were I to treat my ſubject ſuperficially, my writings would be of no uſe to any body, and my labour would be loſt; but by inveſtigating it thoroughly, I may perhaps engage others to pay that attention to it, which, from its importance to ſociety, it certainly deſerves. If improvements in articles of elegant luxury, which not one perſon in ten thouſand is rich enough to purchaſe, are conſidered as matters of public concern, how much more intereſting to a benevolent mind muſt thoſe improvements be, which contribute to the comfort and convenience of every claſs of ſociety, rich and poor.

But the ſubject now under conſideration is very far from being unintereſting, even if we conſider it merely as it is connected with *ſcience*, without any immediate view to its utility; for in it are involved ſeveral of the moſt abſtruſe queſtions relative to the doctrine of heat.

Many have objected to the Roaſter, on a ſuppoſition that meat cooked in it muſt neceſſarily partake more of the nature of *baked* meat than of *roaſted* meat. The general appearance of the machinery is certainly calculated to give riſe to that idea, and when it is known that all kinds of baking may be performed in great perfection in the Roaſter, that circumſtance no doubt tended very much to confirm the ſuſpicion: but when we examine the matter attentively, I think we ſhall find that this objection is not well founded.

When any thing is baked in an oven, (on the common conſtruction) the heat is gradually *diminiſhing* during the whole time the proceſs is going on.—In the Roaſter, the heat is regulated at pleaſure, and can be ſuddenly increaſed towards the end of the proceſs; by which means the diſtinguiſhing and moſt delicate operation, *the browning of the ſurface* of the meat, can be effected in a few minutes, which prevents the drying up of the meat, and the loſs of its beſt juices.

In an oven, the exhalations being confined, the meat ſeldom fails to acquire a peculiar and very diſagreeable ſmell and taſte, which, no doubt, is occaſioned ſolely by thoſe confined vapours. The ſteam tube of a Roaſter being always ſet open, when, in browning the meat, the heat is ſufficiently raiſed to evaporate the oily particles at its ſurface, the noxious vapours unavoidably generated in that proceſs are immediately driven away out of the Roaſter, by the current of hot and pure air from the blow-pipes. This leaves the meat perfectly free, both from the taſte and the ſmell peculiar to baked meat.

Some have objected to Roaſters, on an idea that as the water which is placed under the meat, is (in part at leaſt) evaporated during the proceſs, this muſt make the meat *ſodden*, or give it the appearance and taſte of meat boiled in ſteam; but this objection has no better foundation, than that we have juſt examined. As ſteam is much lighter than air, that generated from the water in the dripping-pan, will immediately riſe up to the top of the Roaſter, and paſs off by the ſteam-tube, and the meat will remain ſurrounded by air, and not by ſteam. But were the Roaſter to be conſtantly full of ſteam, to the perfect excluſion of all air, which however is impoſſible, this would have no tendency whatever to make the meat *ſodden*. It is a curious fact, that ſteam, ſo far from being a moiſt fluid, is perfectly *dry*, as long as it retains its elaſtic form; and that it is of ſo drying a nature, that it cannot be contained in wooden veſſels, (however well ſeaſoned they may be) without drying them and making them ſhrink till they crack and fall to pieces.

Steam is never moiſt. When it is condenſed with cold it becomes *water*, which is moiſture itſelf; but the ſteam in a Roaſter, which ſurrounds meat that is roaſting, cannot be condenſed upon it; for the ſurface of the meat, being heated by the calorific rays from the top and ſides of the Roaſter, is even hotter than the ſteam.

If ſteam were a moiſt fluid, it would be found very difficult to bake bread, or any thing elſe, in a common oven.

Meat which is *boiled* or *ſodden* in ſteam, is put cold into the containing veſſel, and the hot ſteam which is admitted, is inſtantly condenſed on its ſurface, and the water reſulting from this condenſation of ſteam, dilutes the juices of the meat, and waſhes them away, leaving the meat taſteleſs and inſipid at its ſurface: but when meat is put cold into a Roaſter, the water in the dripping-pan being cold likewiſe, long before it can acquire heat ſufficient to make it boil, the ſurface of the meat will become too hot for ſteam to be condenſed upon it; and were it not to be browned at all, it could not poſſibly taſte *ſodden*.

It appears to me, that theſe illucidations are ſufficient to remove the two objections which are moſt commonly made to the Roaſter, by thoſe who are not well acquainted with its mechaniſm, and manner of acting.

In my account of the blow-pipes, I have ſaid that the current of air which comes into the Roaſter through them, when they are opened to brown the meat, "drives away all the moiſt air and vapour "out of the Roaſter." This I well know is not an accurate account of what really happens; but it may ſerve, perhaps better than a more ſcientific explanation, to give the generality of readers diſtinct ideas of the nature of the effects that are produced by them. The noxious vapour generated from the oily particles that are evaporated by the ſtrong heat, are moſt certainly driven away, preciſely in the manner deſcribed; and we have juſt ſeen how very eſſential it is that theſe vapours ſhould not be permitted to remain in the Roaſter;—and whether the ſurface of the meat be in fact dried by the immediate contact of a current of hot and dry air, or whether this effect is produced in conſequence of an increaſe of calorific rays from the top and ſides of the Roaſter, occaſioned by the additional heat communicated to the internal ſurface of the Roaſter by this hot wind, the utility of the blow-pipes is equally evident in both caſes.

CHAPTER V.

More particular deſcriptions of the ſeveral parts of the Roaſter, deſigned for the information of workmen—Of the body of the Roaſter—Of the advantages which reſult from its peculiar form—Of the beſt method of proceeding in covering the iron doors of Roaſters, and Ovens, with pannels of wood, for confining the heat—Method of conſtructing double doors of ſheet iron, and of caſt iron—Of the blow-pipes—Of the ſteam tube—Of the dripping-pan—Precautions to be uſed for preventing the too rapid evaporation of the water in the dripping-pan—Of large Roaſters that may be uſed for roaſting and baking at the ſame time—Precautions which become neceſſary when Roaſters are made very large—Of various alterations that may be made in the forms of Roaſters, and of the advantages and diſadvantages of each of them—Account of ſome attempts to ſimplify the conſtruction of Roaſters—Of a Roaſting-oven—Of the difference between a Roaſting-oven, and a Roaſter.

ALTHOUGH it will be eaſy for perſons acquainted with the mechanic arts, and accuſtomed to examine drawings and deſcriptions of machines, to form a perfect idea of the invention in queſtion, from what has already been ſaid, yet ſomething more will be neceſſary for the inſtruction of artificers, who may be employed in executing

ing the work, and more eſpecially for ſuch as may from theſe deſcriptions undertake to conſtruct Roaſters, without ever having ſeen one. By going into theſe details, I ſhall no doubt find opportunities for introducing occaſional remarks on the uſes and management of the various parts of the machinery; which will tend not a little to illuſtrate the foregoing deſcriptions, and enable the reader to form a more preciſe and ſatisfactory opinion reſpecting the merit of the contrivance.

Of the BODY *of the Roaſter.*

Although I have directed the Body of the Roaſter to be made cylindrical, it may, without any conſiderable inconvenience, be conſtructed of other forms. The reaſons why I preferred the cylindrical form to all others, were, becauſe I was told by workmen, that it was the form of eaſieſt conſtruction; and becauſe I knew it to be the form beſt adapted for ſtrength and durability.

There is another reaſon, which I did not dare to communicate to the workmen (iron-plate workers) whom I was obliged to employ, in order to introduce this contrivance into common uſe in this country; when Roaſters are of this form, it will be eaſy to make them of *caſt-iron*, which will render the article not only cheaper to the purchaſer, but alſo much more durable, and better on many accounts.

As there is a certain proportion of ſulphur in the coal commonly uſed in this country, I was always perfectly aware of the conſequences of burning it *under* Roaſters conſtructed of ſheet-iron. I knew that the ſulphureous vapour from ſuch fuel would be much more injurious to the Roaſter, and eſpecially to its blow-pipes (which are much expoſed) than the clear flame of a wood fire; but I truſted to the remedy, which I knew might eaſily be provided for this defect. I thought that *caſt-iron*, which is much leſs liable to be injured by a coal fire, than wrought iron, would ſoon be ſubſtituted in lieu of it, firſt for the blow-pipes, and then for the body of the Roaſter. In this expectation I have not been diſappointed, for the blow-pipes of Roaſters are now commonly made of caſt-iron by the London workmen; and where ſea-coal is uſed as fuel, they never ſhould be made of any other material.

The firſt Roaſters I cauſed to be made, had all flat bottoms, and their ſides were vertical, and their tops were arched over in the form of a trunk; but ſeveral inconveniencies were found to reſult from this ſhape. Their bottoms were too much expoſed to the heat, and this exceſſive heat in that part heated the bottom of the dripping-pan too much, and cauſed the water in it to be ſoon evaporated; it likewiſe cauſed them to warp, and ſometimes prevented their doors from cloſing them with that preciſion which is neceſſary.

If the hot air in a Roaſter be permitted to eſcape by the crevices of its door, or what is ſtill worſe and more likely to happen, if cold air be permitted to enter the Roaſter by thoſe openings, it is quite impoſſible that the proceſs of roaſting can go on well.

As cold air will always tend to preſs into the body of the Roaſter by every paſſage that is left open, whenever, the Roaſter being hot, the damper of its ſteam-tube is open; this ſhows how neceſſary it is, in roaſting meat, not to leave that damper open at any time when it ought to be kept cloſed.

As iron doors, for confining heat, are very liable to be warped by the expanſion of the metal, they ſhould never be made to ſhut into grooves, but they ſhould be made to cloſe tight by cauſing the flat ſurface of the inſide of the door to lie againſt, and touch in all parts, the front edge of the door frame; which front edge muſt of courſe be made to be perfectly level, and as ſmooth as poſſible.

When the body of the Roaſter is made cylindrical, it will be eaſier to make the front of it, againſt which its door cloſes, level, than if it were of any other form; and when the door is circular, by making it a little diſhing, it will not be liable to be warped; eſpecially when it is made double.

If the front end of the cylinder of ſheet-iron which forms the body of the Roaſter, be turned outwards over a very ſtout iron wire, (about one-third of an inch in diameter for inſtance,) this will ſtrengthen the Roaſter very much, and will render it eaſier to make the end of the Roaſter level, to receive the flat ſurface of its door: it can moſt eaſily be made level by placing the cylinder in a vertical or upright poſition, with its open end downwards, on a flat anvil, and hammering the wire above mentioned, till its front edge, which repoſes on the anvil, is quite level.

In order that the door of the Roaſter may cloſe well, its hinges ſhould be made to project outwards two or three inches beyond the ſides of the Roaſter; and it ſhould be faſtened, not by a common latch, but by two turn-buckles, ſituated juſt oppoſite to the two hinges. The diſtance at which the two hinges (and conſequently the two turn-buckles) ſhould be placed from each other, ſhould be equal to half the diameter of the Roaſter.

The hooks for the hinges, and alſo the ſupport for the turn-buckles, ſhould be ſituated at the projecting ends of ſtrong iron ſtraps, faſtened at one of their ends to the outſide of the Roaſter, by means of rivetting-nails. The manner in which theſe turn-buckles are conſtructed, and the manner in which they are faſtened to the Roaſter, may be ſeen by examining figure 17, where they are repreſented on a large ſcale.

The firſt Roaſters that were made were furniſhed with two ſeparate doors, the one placed about four inches within the body of the Roaſter, the other even with its front. As the inſide door had no hinges, but, like a common oven door, was taken quite away when the Roaſter was opened; there was ſome trouble in the management of it; and it was found that the cooks, to avoid that trouble, frequently threw it away, and uſed the roaſter without it. This contrivance of the cooks to ſave trouble, came very near to diſcredit the Roaſters altogether, and to put a final ſtop to their introduction in this country. The circumſtance upon which the principal merit of the Roaſter depends, and on which the excellence of the food cooked in it depends entirely, is the *equality of the heat.* When the heat is equal on every ſide, it may be more *moderate* than when it is unequal; and the more moderate and equal the heat is by which meat can be properly roaſted, the better taſted and more wholeſome will it be. Now it is quite impoſſible to keep up an *equal* heat in a Roaſter which is cloſed only by a ſingle door of ſheet-iron; for ſo much heat will paſs off *through* ſuch a thin metallic door, and be carried away by the cold air of the atmoſphere which is lying againſt the outſide of it, that the degrees of heat in different parts of the Roaſter muſt neceſſarily be very different; and the conſequence of this inequality will be, either that the meat will not be ſufficiently done in ſome parts, or that the heat muſt be ſo much increaſed as to prevent its being well done in any part.

In order to induce perſons to be careful in the management of machinery of any kind which is new to them, it is neceſſary to point out the bad conſequences which will reſult from ſuch neglects and inattentions as they are moſt liable to fall into in the uſe of it; for, however particular inſtructions may be, ſtrict attention to them cannot be expected from thoſe who are not aware of the bad effects that may reſult, from what may appear to them very trifling deviations or neglects.

Thoſe who make Roaſters muſt take the greateſt care to conſtruct them in ſuch a manner that they may be accurately cloſed, and that the heat may not be able to make its way *through* their doors;—and thoſe who uſe them, muſt be careful to manage them properly.

There are two ways in which the door of a Roaſter may be conſtructed, ſo as to confine the heat perfectly well, without giving any additional trouble to the cook in the management of it. It may be made of a ſingle ſheet of iron, and covered on the outſide with a pannel of wood:—or it may be conſtructed of two ſheets of iron, placed parallel to each other, at the diſtance of about an inch, and ſo faſtened together that the air between them may be confined.

When a door of ſingle ſheet iron is made to confine the heat by means of an outſide covering of wood, care muſt be taken to make ſuch outſide wooden covering in the form of a *pannel,* otherwiſe it will not anſwer. If a *board* be uſed inſtead of a framed pannel it will moſt certainly warp with the heat, and will either detach itſelf from the iron door to which it is faſtened, or will cauſe the door to bend, and prevent its cloſing the Roaſter with ſufficient accuracy. I have ſeen ſeveral attempts made to uſe boards, inſtead of pannels, in covering the outſides of the iron doors of Roaſters, and iron ovens; but they were all unſucceſsful. It is quite impoſſible that they ever ſhould anſwer, as will be evident to thoſe who will take the trouble to conſider the matter with attention.

As Doors of ſheet iron, covered with wood on the outſide, when they are properly conſtructed, are admirably calculated for confining heat; I think it worth while to give a detailed account of the precautions that are neceſſary in the conſtruction of them.

Of the beſt Method of covering the Iron Doors of Roaſters and Ovens, &c. with Wooden Pannels, for confining the Heat.

The object principally to be attended to in this buſineſs, is to contrive matters ſo that the ſhrinking and ſwelling of the wood by alternate heat and moiſture, ſhall have no tendency either to detach the wood from the iron-door, or to change its form; or to cauſe openings in the wood by which the air confined between the wood and the iron can make its eſcape.

The manner in which this may, in all caſes, be done, will be evident from an examination of the figure 18, which repreſents a front view of the door of a cylindrical Roaſter, 18 inches in diameter, covered with a ſquare wooden pannel.

It will be obſerved, that this pannel conſiſts of ſquare frame tenanted, and faſtened together at each of its four corners with a ſingle pin; and filled up in the middle with a ſquare board or pannel, which is confined in its place, by being made to enter into deep grooves or channels, made to receive it, in the inſides of the pieces which form the frame. The circular iron door to which this pannel is fixed, cannot be ſeen in the figure, being covered and concealed from view by the wood, but its ſize and poſition are marked out by a dotted circle; and the heads of ten rivets are ſeen, by which the wooden pannel is faſtened to the iron door. Theſe rivets are made to hold the wood faſt to the iron by means of ſmall circular plates of ſheet iron, which are diſtinctly repreſented in the figure*.

If the poſitions of the pins by which the wooden frame is faſtened together, and of the rivets which faſten the pannel to the iron door, are conſidered, it will be evident, that all bad effects of the ſhrinking of the wood by the heat are prevented by the propoſed conſtruction. The four pieces of wood, which conſtitute the frame of the pannel (which may be of common deal, and about four inches wide, and one inch thick), being faſtened with one pin only at each of their joinings at the corners, and theſe pins being ſituated in the center of thoſe joinings, if upon the frame, in the middle of each of the four pieces which compoſe it, a ſquare be drawn in ſuch a manner that the corners of this ſquare may coincide with the centers of the four pins which hold the frame together, as neither heat nor dryneſs makes any conſiderable alteration in the length of the fibres of wood, it is evident that the ſhrinking of the four pieces which compoſe this frame, cannot alter the dimenſions of this ſquare, or in any way change its poſition. If, therefore, care be taken in faſtening the pannel to the iron door to place the rivetting-nails *in the lines which form the four ſides of this ſquare*, the ſhrinking of the wood will occaſion no ſtrain on the iron door, nor have any tendency whatever to change its form; and with regard to the center piece of the pannel, if it be faſtened to the iron door by two rivets, ſituated *in the direction of the fibres of the wood*, in a line dividing this piece into two equal parts, its ſhrinking will be attended with no kind of inconvenience. Care ſhould however be taken to make this pannel enter ſo deeply into the grooves in its frame, that when it has ſhrunk as much as poſſible, its width ſhall not be ſo much reduced as to cauſe it to come quite out of the grooves. This piece may be made about one-third of an inch thick; and the grooves which receive it may be made of the ſame width, and about three quarters of an inch deep.

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* Inſtead of theſe rivets, ſhort wood ſcrews may be uſed for faſtening the wooden pannel to the iron door; but care muſt be taken to place theſe ſcrews in the ſame places which are pointed out for the rivets. The heads of the wood ſcrews muſt of courſe be on the inſide of the iron door.

When wooden covers of this kind are made for iron doors of large dimenſions, they ſhould be divided into a number of compartments, otherwiſe the center pieces, or the pannels, properly ſo called, being very large, the ſhrinking of the wood with heat will be apt to make them quit the grooves of their frames, which would open a paſſage for the cold air to approach the ſurface of the iron door.

In faſtening the wooden pannel to its iron door, it will be beſt that the wood ſhould not come into immediate contact with the iron. Two or three ſheets of cartridge paper placed one upon the other, may be interpoſed between them; and to prevent the poſſibility of this paper taking fire, it may previouſly be rendered incombuſtible by ſoaking it in a ſtrong ſolution of alum, mixed with a little armenian bole, or common clay. This paper will not only aſſiſt very much in confining the heat, but will alſo effectually prevent the wood from being ſet on fire by heat communicated through the iron door of the Roaſter. It is indeed highly improbable that the Roaſter ſhould ever be ſo intenſely heated as to produce this effect; but as the ſtrangeſt accidents ſometimes do happen, it is always wiſe to be prepared for the worſt that can happen.

As the center piece of wood, or pannel properly ſo called, which fills up the wooden frame, is only one-third of an inch in thickneſs, while the frame is one inch in thickneſs, it is evident that if the face of the frame be made to apply every where to the flat ſurface of the iron door, the center piece will not touch it. This circumſtance will be rather advantageous than otherwiſe, in confining the heat; but ſtill it will require ſome attention in faſtening the wood to the iron. Each of the two rivets which paſs through this center piece, muſt alſo be made to paſs through a ſmall block of wood, about an inch ſquare for inſtance, and one-third of an inch thick, which will give theſe rivets a proper bearing, without any ſtrain on the iron door which can tend to alter its form.

When the wood and the iron are firmly rivetted together, the ſuperfluous paper may be taken away with a knife.

The hinges of the door, which in the figure 18 are ſeen projecting outwards on the right hand, are to be rivetted to the outſide ſurface of the circular iron door; and in order that they may not prevent the pannel from applying properly to the door, they are to be let into the wood. The turn-buckles, by which the door is faſtened, muſt be made to preſs againſt the outſide or front of the wooden frame.

No inconvenience of any importance will ariſe from leaving the wooden pannel ſquare, while the door itſelf is circular; but if it ſhould be thought better, the corners of the pannels may be taken off, or the wooden pannel may be made circular; this ſhould not however be done till after the pannel has been fixed to the door. After this has been done, as the rivets will be ſufficient to hold the ſides of the frame in their places, the cutting off of the corners of the frame will produce no bad conſequences.

I have been the more particular in my account of the manner of covering iron doors with wooden pannels, for the purpoſe of confining heat, as this contrivance may be uſed with great advantage, not only for Roaſters and Ovens, but alſo for a variety of other purpoſes; for the covers of large boilers for inſtance, for the doors of hot cloſets, ſteam cloſets, &c.

Of Double Doors for Roaſters, conſtructed of two circular pieces of Sheet-Iron ſeamed together.

No difficulty will be found in the conſtruction of theſe doors; and though they may not perhaps confine the heat quite ſo perfectly as the doors we have juſt deſcribed, they anſwer very well; and when the outſide of the door is japanned, they have a very handſome and cleanly appearance.

There are two ways of conſtructing them, either of which may be adopted; the circular ſheet of iron which forms the inſide of the door, may be flat, and the outſide ſheet diſhing; or the outſide ſheet may be flat, and the inſide ſheet diſhing; but whichſoever of theſe methods is adopted, the hinges muſt be attached to the outſide of the door; and care muſt be taken to make that part of the inſide of the door quite flat which lies againſt the end of the Roaſter, and cloſes it. The diſtance of the inſide ſheet of iron and the outſide ſheet, is not very eſſential; it ſhould not however be leſs than one inch in the center of the door; and theſe two ſheets ſhould not touch each other any where, except it be at their circumference, where they are faſtened together. In the center of the outſide ſheet there ſhould be fixed a knob of iron, or of braſs, to ſerve as a handle for opening and ſhutting the door.

Double doors of this kind might eaſily be conſtructed of two circular pieces of caſt iron, faſtened together by rivets; or of one piece of caſt iron, caſt diſhing, and a flat piece of ſheet iron turned over it. When the latter conſtruction is adopted, the caſt iron muſt form the inſide of the door, and its convex ſide muſt project into the Roaſter. It ſhould be quite flat near its circumference, in order that it may cloſe the Roaſter with accuracy, and it ſhould be at leaſt three quarters of an inch larger in diameter than the Roaſter, in order that no part of the circular plate of ſheet iron, which ſhould be faſtened to it by being turned over its edge, may get between it and the end of the Roaſter.

Of the Blow Pipes.

There are various ways in which the Blow-Pipes may be faſtened to the Roaſter. The common method, when they are made of ſheet iron, is to faſten them with rivets; but as blow-pipes of ſheet-iron are liable to be burnt out in a few years, if much uſed, it is better to procure them of caſt-iron from an iron-founder, in which caſe they ſhould be caſt with flanches, and ſhould be keyed on the inſide of the Roaſter; and their joinings with the bottom of the Roaſter muſt be made tight with ſome good cement that will ſtand fire, and is proper for that uſe.

The effect of the blow-pipes will be conſiderably increaſed, if a certain quantity of iron wire, in looſe coils, or of iron turnings, be put into them. Theſe being heated by the fire, the air which paſſes through the tubes, coming into contact with them, will be more heated than it would be if the tubes were empty; but care muſt be taken that the quantities of theſe ſubſtances uſed, be not ſo great as to choke up the tube and obſtruct too much the paſſage of the air.

The ſtoppers of the blow-pipes muſt be made to cloſe them well, otherwiſe air will find its way through the blow-pipes into the Roaſter at times when it ought not to be admitted. One of theſe ſtoppers, repreſented on a large ſcale, is ſeen drawn a little way out of its blow-pipe, in the figure 17; and in that figure, part of the iron ſtrap is ſeen which ſupports the front ends of the two blow-pipes, and confines them in their places. This ſtrap will not appear when the Roaſter is ſet, for it will then be entirely covered and concealed by the brick-work.

Where blow-pipes are made of ſheet iron, they ſhould be ſo conſtructed and ſo faſtened to the Roaſter, that they may at any time be removed and replaced without taking the Roaſter out of the brick-work. This is neceſſary, in order that they may be taken away to be repaired or replaced with new ones, when by long uſe they become burnt out and unfit for ſervice. If they be made with flanches, and keyed on the inſide, and if they be ſupported in front on an iron ſtrap of the form repreſented in figure 14, they may at any time be removed with little trouble, by unkeying them, and removing a few bricks. When the bricks in front, which it will be neceſſary to take away, are removed, this will open a paſſage into the fire-place ſufficiently large to come at the wall at the farther end of the fire-place, which muſt come away in order to diſengage the farther ends of the blow-pipes, which are fixed in it. This wall muſt be carefully built up again, after the new blow-pipes have been introduced and faſtened to the Roaſter.

Of the Steam Tube.

THIS is an eſſential part of the machinery of a Roaſter, and muſt never be omitted. It ſhould be ſituated ſomewhere in the upper part of the Roaſter, but it is not neceſſary that it ſhould be placed exactly at the top of it. It might perhaps be thought that a hole in the upper part of the door would ſerve the purpoſe of a ſteam-tube; but this contrivance would not be found to anſwer. A ſteam-tube, properly conſtructed, will have what is called *a draft* through it, which on ſome occaſions will be found to be very uſeful, but an hole in the door, unconnected with a tube could have no draft. It is abſolutely neceſſary that there ſhould be a damper in the ſteam-tube. The ſimpleſt damper is a circular plate of iron, a very little leſs in diameter than the tube, which, being placed in it, is moveable about an axis, which is perpendicular to the axis of the tube. This circular plate being turned about, and placed in different poſitions in the tube, by means of its axis, which, being prolonged, comes forward through the brick-work, the paſſage of the ſteam through the tube is more or leſs obſtructed by it. This prolonged axis, which may be called the projecting handle of this damper, is repreſented in the figures 14, 15, and 17. This appears to me to be one of the ſimpleſt kind of dampers I am acquainted with; and it has this in particular to recommend it, that it may be regulated without opening any paſſage into the ſteam-tube, or into the Roaſter, by which the air could force its way.

Of the Dripping Pan.

As the principal dripping-pan of a Roaſter is deſtined for holding water, and as it is of much importance that it ſhould not leak, it ſhould be hammered out of one piece of ſheet-iron, in the ſame manner as a frying-pan is formed; or if the metal be turned up at the corners, it ſhould be lapped over, but not cut, and all rivetting-nails ſhould be avoided, except ſuch as can be placed very near the edge of the pan, and above the common level of the water that is put into it. To avoid the neceſſity of placing any rivetting-nail at the bottom of the pan, or near it, in faſtening the ſliders on which the pan runs, theſe ſliders ſhould be made to paſs upwards, by the ends of the pan, in order to their being faſtened to it near its brim.

The dripping pan ſhould not be made quite ſo long as the Roaſter, for room muſt be left between the farther end of it and the farther end of the Roaſter, for the hot air from the blow-pipes to paſs up into the upper part of the Roaſter. In order to ſtop the dripping-pan in its proper place, when it is puſhed into the Roaſter, the farther end of the ſhelf on which it ſlides, may be turned upwards, and the brim of the dripping-pan made to ſtrike againſt this projecting part of the ſhelf. The opening between this projecting part of the ſhelf, and the farther end of the Roaſter, ſhould be about one inch, or 1 ¼ inches wide, and it may be juſt as long as the dripping-pan is wide at the brim. This part of the ſhelf which projects upwards, ſhould be half an inch higher than the brim of the dripping-pan, in order to prevent the current of hot air from the blow-pipes from ſtriking againſt the end of the dripping-pan, and heating it too much. The ſhelf may be ſtopped in its proper place, by means of two horizontal projecting ſlips of iron, about one inch, or 1 ¼ inches long, each, at its farther end, which, ſtriking againſt the end of the Roaſter, will prevent the ſhelf from being puſhed too far into it. The dripping-pan ſhould have two falling handles, one at each end of it, which handles ſhould have ſtops to hold them faſt when they are raiſed into an horizontal poſition. As theſe handles will neceſſarily project a little beyond the ends of the pan, even when they are not raiſed up, the handle at the farther end of the pan will prevent the brim of the pan from actually touching the projecting end of the ſhelf; which circumſtance will be advantageous, as it will ſerve to defend the end of the pan, and prevent its being ſo much heated as otherwiſe it would be by the hot air from below.

I find, on enquiry from ſeveral perſons who have lately made the experiment, that it is by far the beſt method to uſe two dripping-pans, one within the other, with water between them. As the upper pan is very thin, being made of tin * (tinned ſheet iron) it is kept as cool as is neceſſary by the water; and the ſurface of the water being covered and protected, it does not evaporate ſo faſt as when it is left expoſed to the hot air in the Roaſter.

Of the Precautions that may be uſed to prevent the Dripping Pan from being too much heated.

THIS is a very important matter, and too much attention cannot be paid to it by thoſe who conſtruct Roaſters. From what has been ſaid, it is evident, that if, in roaſting meat, the water in the dripping-pan ever happens to be all evaporated, the drippings from the meat which fall on it cannot fail to fill the Roaſter with noxious fumes. It is certainly not ſurprizing that thoſe who, in roaſting in a Roaſter, neglected to put water into the dripping-pan, ſhould not much like the flavour of their roaſted meat.

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* Some perſons have uſed a ſhallow earthen diſh, inſtead of this ſecond dripping-pan; but earthen ware does not anſwer ſo well for this uſe as tin, as it is more liable to be heated too much by the radiant heat from above.

There is a method of defending the dripping-pan from heat, which many have put in practice with ſucceſs; but although it effectually anſwers the purpoſe, yet it is attended with a ſerious inconvenience, which, as it is not very obvious, ought to be mentioned. When the bottoms of Roaſters were made flat, their dripping-pans were much more liable to be too much heated than they are when the body of the Roaſter being made cylindrical, the dripping-pan is placed on a ſhelf in the manner I have here recommended. And ſeveral perſons finding the water in the dripping-pans of their Roaſters to boil away very faſt, covered the (flat) bottoms of their Roaſters with ſand, or with a paving of thin tiles, or bricks. This produced the deſired effect; but this contrivance occaſions the bottom of a Roaſter to be very ſoon burnt out and deſtroyed. The heat from the fire communicated to the under ſide of the bottom of the Roaſter not being able to make its way upwards into the body of the Roaſter, through the ſtratum of ſand or bricks (which ſubſtances are non-conductors of heat) it is accumulated in the bottom of the Roaſter, and becomes there ſo intenſe as to deſtroy the iron in a ſhort time.

The beſt method that can be adopted for preventing the dripping-pan from being too much heated, is to defend the bottom of the Roaſter from the direct action of the fire, by interpoſing a ſcreen of ſome kind or other between it and the burning fuel. This ſcreen may be a plate of caſt iron, about one third of an inch thick, with a number of ſmall holes through it, ſupported upon iron bars at the diſtance of about an inch below the bottom of the Roaſter;—or it may be formed of a row of thin flat tiles laid upon the blow-pipes, and ſupported by them.

Roaſters which are made of a cylindrical form, will hardly ſtand in need of any thing to ſcreen them from the fire; eſpecially if their fire-places are ſituated at a proper diſtance below them, and if the ſize of the fire is kept within due bounds. But after all, if the perſon to whom the management of a Roaſter is committed is determined to deſtroy it, no precautions can prevent it; and hence it appears how very neceſſary it is to ſecure the good will of the cooks. They ought certainly to wiſh well to the ſucceſs of theſe inventions; for the introduction of them cannot fail to diminiſh their labour, and increaſe their comforts very much.

Of large Roaſters, that will ſerve to ROAST *and* BAKE *at the ſame Time.*

IT has been found by experience that any Roaſter may be made to roaſt and bake at the ſame time, in great perfection, when the proper precautions are taken; but this can beſt be done when the Roaſter is of a large ſize, from 20 inches to 24 inches in diameter, for inſtance; for in this caſe there will be room above the meat for a ſhelf on which the things to be baked can be placed. And even when there is no roaſting going on below it, any thing to be baked ſhould be placed on this ſhelf, in order to its being nearer to the top of the Roaſter, where the proceſs of baking goes on better than any where elſe. In baking bread, pyes, cakes, &c. it ſeems to be neceſſary that the heat ſhould *deſcend* in rays from the top of the oven, and as the intenſity of the effects produced by the calorific rays which proceed from a heated body, is much greater near the hot body than at a greater diſtance from it, (being moſt probably as the ſquares of the diſtances inverſely) it is evident why the proceſs of baking ſhould go on beſt in a low oven, or when the thing to be baked is placed near the top of the oven, or of the Roaſter, when it is baked in a Roaſter.

The ſhelf in the upper part of a Roaſter for baking, may be made of a ſingle piece of ſheet-iron, but it will be much better to make it double, that is to ſay, of two pieces of ſheet-iron, placed at a ſmall diſtance from each other, and turned inwards, and faſtened together at their edges, in the manner which will preſently be more particularly deſcribed. This ſhelf, whether it be made ſingle or double, ſhould be placed upon ledges, rivetted to the ſides of the Roaſters; and to prevent the hot air from the blow-pipes from paſſing up between the farther end of this ſhelf and the farther end of the Roaſter, the ſhelf ſhould be puſhed quite back againſt the end of the Roaſter. It ſhould be made ſhorter than the Roaſter by about two inches, in order that there may be ſufficient room between the hither end of the ſhelf and the inſide of the door of the Roaſter, for the vapour that ought to be driven out of the Roaſter to paſs upwards to the opening of the ſteam-tube. This ſhelf ſhould not be faſtened in its place, for it may ſometimes, when very large pieces of meat are roaſted, be found neceſſary to remove it.

As it ſeems probable that *radiant heat* from the top and ſides of the Roaſter, acts an important part, even in the proceſs of roaſting, if a Roaſter of very large dimenſions were to be conſtructed, I think it would be adviſeable not to make its tranſverſe ſection circular, but elyptical, the longeſt axis of the elypſe being in an horizontal poſition. This form would bring the top of the Roaſter to be nearer to the meat than it would be if its form were cylindrical; its capacity remaining the ſame.

How far an horizontal ſhelf of ſheet iron, placed immediately over the meat, and *very near it*, would anſwer as a remedy for the defect of a Roaſter, the top of which, on account of its great ſize, ſhould be found to be too far from the ſurface of the meat, I cannot pretend to determine, as I never have made the experiment; but I think it well deſerving of a trial. If the farther end of this ſhelf were made to touch the farther end of the Roaſter, ſo as to prevent the current of air from the blow-pipes from getting up between them, it is very certain that this hot air would be forced to impinge againſt the ſhelf, and run along the under ſide of it, to the hither end of the Roaſter. The only queſtion remaining, and which can only be determined by experiment, is, whether this hot air would heat the ſhelf *ſufficiently*, or to that temperature which is neceſſary, in order that the iron may throw off thoſe calorific rays which are wanted.

If this ſhelf were covered above with a pavement of tiles, or if it were conſtructed of two ſheets of iron placed parallel to each other, at the diſtance of about one inch, turned in, or made diſhing at their edges, and ſeamed together at their ends and ſides in ſuch a manner as to confine the air ſhut up between them, either of theſe contrivances, by obſtructing the heat in its paſſage *through* the ſhelf, would promote its accumulation at its under ſurface, which would not only increaſe the intenſity of the radiant heat where it is wanted, but, by diminiſhing the quantity of heat which paſſes *through* the ſhelf, would be very uſeful when any thing is placed on it in order to be baked.

Whenever a ſhelf is made in a Roaſter, whether it be ſituated above the dripping-pan or below it, I think it would always be found advantageous to conſtruct it in the manner here deſcribed, viz. of two ſheets of iron, with confined air between them; or perhaps it may be ſtill better to fill this cavity with finely pulverized charcoal. The additional expence of conſtructing the ſhelves of Roaſters in this manner would be but trifling; and the paſſage of the heat *through them*, which it is always deſirable to prevent as much as poſſible, will, by this ſimple contrivance, be greatly obſtructed. If the lower ſhelf be ſo conſtructed, it will no doubt be found very uſeful in preventing the too quick evaporation of the water in the dripping-pan.

Of various alterations that have been made in the forms of Roaſters, and of the advantages and diſadvantages of each of them.

THE blow-pipes of all the Roaſters that were conſtructed, till very lately, were made to paſs round to the farther end of the Roaſter; and after forming two right angles each, they entered the Roaſter, in an horizontal direction, juſt above the level of the brim of the dripping-pan, in the manner repreſented in the figure 19.

The figure 20 ſhows the manner in which the blow-pipes have been conſtructed of late.

The advantages of the former conſtruction were, a great length of tube, and conſequently a greater effect on that account; and a good direction to the current of hot air: the diſadvantages were, the difficulty of removing the tubes to repair them, without unſetting the Roaſter; and the difficulty of procuring blow-pipes of this form, of caſt iron; and laſtly, the great depth of ſpace that was required for ſetting the Roaſter.

The advantages of the blow-pipe, repreſented in figure 20, have already been noticed. The diſadvantage from want of length, is compenſated by a ſmall increaſe of diameter. When this blow-pipe is faſtened to the Roaſter, its flanch is covered with a cement, and the vertical end of the pipe being introduced into the Roaſter, through the circular hole in the bottom of it, which is made to receive it, a flat iron ring, covered with cement on its under ſide, is then ſlipt over the end of the tube within the Roaſter, and a key of iron, in the form of a wedge, being paſſed through both ſides of the tube, in holes prepared to receive it, by driving this wedgelike key with a hammer, the ring is forced downwards, and at the ſame time the flanch of the blow-pipe is forced upwards againſt the bottom of the Roaſter, by which means the blow-pipe is firmly fixed in its place, and the cement makes the joinings air-tight. By removing this key, the pipe may at any time be removed without deranging the Roaſter.

The figure 19 repreſents the ſection of a flat-bottomed Roaſter. In this there is a ſhelf on which two pies are ſeen baking, and a piece of meat is repreſented lying on the gridiron.

In the figures 14 and 15, the front or hither end of the Roaſter is repreſented as being turned over a ſtout iron wire. The firſt Roaſters that were conſtructed were all made in a different manner. The hither end of the Roaſter was rivetted to a broad flat frame, conſtructed of ſtout plate iron; and to this frame, or flat front, which projected before the brick-work, the hinges and turn-buckles of the door were faſtened. An idea of this manner of conſtructing the front of a Roaſter may be formed from the figure 21, although this figure does not repreſent the front of a Roaſter, but that of an oven, which will be deſcribed preſently.

There is no objection to this method of conſtructing Roaſters, but the expence of it.

Of ſome attempts to ſimplify the Conſtruction of the Roaſter.

Finding that much more heat was always communicated to the under-ſides of Roaſters, eſpecially as they were firſt conſtructed (with flat bottoms) than was there wanted, meditating on the means I could employ to defend the bottom of the dripping-pan from this exceſſive heat, without, at the ſame time, expoſing the bottom of the Roaſter to the danger of being ſoon deſtroyed, in conſequence of the accumulation of it, on its paſſage upwards being prevented; it occurred to me, that if the bottom of the Roaſter were covered with a ſhallow iron pan turned upſide down, with a row of holes from ſide to ſide at the farther end of it, and if a certain quantity of freſh air could occaſionally be admitted under this inverted pan; this cold air, on coming into contact with the bottom of the Roaſter would take off the heat, and becoming ſpecifically lighter on being heated, would paſs upwards through the holes at the farther end of this pan into the Roaſter, ſerving at the ſame time three uſeful purpoſes, namely, to defend the dripping-pan;—to cool the bottom of the Roaſter; —and to aſſiſt in heating the inſide of the Roaſter, above, where heat is moſt wanted. This invention was put in practice, and was found to anſwer very well all the purpoſes for which it was contrived. It was likewiſe found, that with proper management the current of heated air from below the inverted pan might be ſo regulated, as to roaſt meat very well without making any uſe of the blow-pipes; and conſequently that Roaſters might be conſtructed without blow-pipes.

As the ſubſtitution of the contrivance above deſcribed in lieu of the blow-pipes would ſimplify the conſtruction of the Roaſter very much, and enable tradeſmen to afford the article at a much lower price, I took a great deal of pains to find out

whether

whether a Roaſter on this ſimple conſtruction could be made to perform as well as thoſe which are made with blow-pipes. I cauſed one of them to be put up in my own houſe, and tried it frequently; and I engaged ſeveral of my friends to try them; and they were found to anſwer ſo well, that I ventured at length to recommend it to manufacturers to make them for ſale. As they were called Roaſters, and as they coſt little more than half what thoſe with blow-pipes were ſold for, many perſons preferred them on account of their cheapneſs, and more than two hundred of them have already been put up in different parts of the country, and I am informed that they have anſwered to the entire ſatisfaction of thoſe who have tried them.

Although they are undoubtedly inferior in ſome reſpects to Roaſters which are furniſhed with blow-pipes, meat may, with a little care and attention, be roaſted in them in very high perfection; and as nothing can poſſibly anſwer better than they do for all kinds of baking, they will, I am perſuaded, find their way in due time into common uſe.

Roaſters on this ſimple conſtruction (without blow-pipes) which I ſhall call *Roaſting Ovens*, were at firſt made with flat bottoms, but of late they have been made cylindrical; and as I think the cylindrical form much the beſt in many reſpects, I ſhall give a deſcription of one of them.

Figure 21 repreſents a front view of a cylindrical Roaſting-Oven with its door ſhut. The front end of the large cylinder, which conſtitutes the body of this oven, inſtead of being turned over a ſtout wire, is turned outwards, and rivetted to a flat piece of thick ſheet iron, which in this figure is diſtinguiſhed by vertical lines, and which I ſhall call *the front* of the oven.

The door of the oven is diſtinguiſhed by horizontal lines. The general form of the front of the oven is circular; but it has two projections on oppoſite ſides of it, to one of which the hinges of the door, and to the other the turnbuckles for faſtening it when it is cloſed, are faſtened. It has another projection above, which ſerves as a frame to the doorway, through which a bruſh is occaſionally introduced for the purpoſe of cleaning the flues. On one ſide of this projection there is a ſmall hole, which is diſtinguiſhed by the letter *a*, through which the handle or projecting axis of the circular regiſter of the vent-tube (which is not ſeen) paſſes.

In the body of the oven, at the diſtance of half its ſemi-diameter below its center or axis, there is an horizontal ſhelf, which is fixed in its place, not by reſting on ledges, or by being rivetted to the ſides of the oven, but by its hither end being turned down, and firmly rivetted to the vertical plate of iron, which I have called the front of the oven. This ſhelf, which ſhould be made *double* to prevent the heat from paſſing through it from below, muſt not reach quite to the farther end of the oven: there muſt be an opening left, about one inch in width, between the end of it and the farther end of the oven, through which opening the air heated below the ſhelf will make its way upwards into the upper part of the oven.

From what has been ſaid, it will be evident that the hollow ſpace below the ſhelf we have juſt been deſcribing, which I ſhall call the *air-chamber*, is intended to ſerve in lieu of the blow-pipes of a Roaſter; and this office it will perform tolerably well, provided means are uſed for admitting cold air into it, from without, occaſionally. This is done by means of a regiſter, which is ſituated at the lower part of the vertical front of the Roaſter, a little below the bottom of the door. This regiſter is diſtinctly repreſented in the figure 21.

Figure 22, which repreſents a vertical ſection of the oven through its axis, ſhows the (double) door of the Roaſter ſhut, and the two dripping-pans, one within the other, ſtanding on the ſhelf we have juſt been deſcribing, and a piece of meat above them, which is ſuppoſed to be laying on a gridiron placed in the ſecond dripping-pan. The regiſter of the air-chamber, below the ſhelf, which ſupplies the place of the blow-pipes, is repreſented as being open; and a part of the ſteam-tube is ſhown, through which the ſteam and vapour are driven out of the oven, by the blaſt of hot air from the air-chamber.

The cylinder which conſtitutes the body of the oven, is two feet long, and is ſuppoſed to be of caſt iron. It is caſt with a flanch, which projects outwards about one inch at the opening of the cylinder, by means of which flanch it is attached, by rivets, to the front of the oven, which, as I have already obſerved, muſt be made of ſtrong ſheet iron, which may be near one-eighth of an inch in thickneſs.

As the ſhelf is not attached to the ſides of the oven, but to its *front*, the body of the oven need not be perforated, except in one place, namely, where the ſteam goes off; and as the bottom, or farther end of the cylinder, and the flanch at its hither end, and the cylinder itſelf, are all caſt at the ſame time, and as the form of the oven is ſuch as will deliver well from the mould, it appears to me that the article might be afforded at a low price, eſpecially in this country, where the art of caſting in iron is carried to ſo high a pitch of perfection.

The ſhelf might eaſily be made of caſt iron, as might alſo the dripping-pans and the double door of the oven; and I ſhould not be ſurprized if Engliſh workmen ſhould ſucceed in making even the front of the oven, and the regiſter of the air-chamber, and every other part of the machinery, of that cheap and moſt uſeful metal.

If the ſhelf be made of caſt iron, to ſave the trouble of rivetting in making it double, it may be covered by an inverted ſhallow pan of caſt iron, and in the bottom of this pan, which will be uppermoſt when it is inverted, there may be caſt two ſhallow grooves, both in the direction of the length of the pan, and conſequently parallel to each other, in which grooves (which may be ſituated about an inch from the ſides of the inverted pan) two parallel projections at a proper diſtance from each other, caſt at the bottom of the lower dripping-pan, may paſs. Theſe projections paſſing freely in the grooves which receive them, will ſerve to keep the dripping-pan ſteady in its proper direction when it is puſhed into or drawn out of the oven.

To increaſe the effect of the air-chamber when this oven is uſed for roaſting meat, a certain quantity of iron wire, in looſe coils, or of iron turnings, may be put into the air-chamber.

The door of the oven, which is very diſtinctly repreſented in the figure 21, ſhould be about 19 inches in diameter, if the oven is 18 inches in diameter within, or in the clear. In this figure the internal edge or corner of the hither end of the body of the oven is indicated by a dotted circle, and the poſition of the ſhelf is pointed out by an horizontal dotted line.

In faſtening the vertical plate, which forms the front of the oven, to the projecting flanch at the hither end of the cylindrical body of the oven, care muſt be taken to beat down the heads of the rivetting nails in front, otherwiſe they will prevent the door of the oven from cloſing it with that nicety which is requiſite.

In ſetting this *Roaſting-Oven*, the whole of the thickneſs of the vertical front of it ſhould be made to project forward before the brick-work, The fire-place doors, aſh-pit, regiſter-door, damper in the chimney, &c. ſhould be ſimilar in all reſpects to thoſe uſed for Roaſters; and the flues ſhould likewiſe be conſtructed in the ſame manner.

I have been the more particular in my deſcription of this *Roaſting-Oven*, becauſe I think it bids fair to become a moſt uſeful implement of cookery. As an oven it certainly has one advantage over all ovens conſtructed on the common principles, which muſt give it a decided ſuperiority; by means of the air-chamber and the ſteam-tube it may be kept clear of all ill-ſcented and noxious fumes, without the admiſſion of cold air.

Of the Difference between a Roaſting-Oven and a Roaſter.

FROM the account of the Roaſting-Oven that has juſt been given, it might be imagined that it poſſeſſes all the properties of the Roaſter, and in the ſame degree; but this is not the caſe. The eſſential difference between them is this; the blow-pipes of the Roaſter being ſurrounded by the flame on all ſides, they are heated *above* as well as below, and the air in paſſing through them is much more expoſed to the heat than it is in paſſing through the air-chamber of the Roaſting-Oven. The particles of air which happen to come into contact with the bottom of the oven will of courſe be heated; but if, in conſequence of their acquired lightneſs on being heated, they riſe upwards to the top of the air-chamber, they will there come in contact with the bottom of the ſhelf, which, inſtead of communicating more heat to them, will deprive them of a part of that which they bring with them from below; but circumſtances are very different in the blow-pipes of a Roaſter; in them, the particles of air acquire continually additional heat from every part of the ſurface with which they come into contact in their paſſage through the tube.

From this view of the ſubject, we ſee how very eſſential it is that the ſhelf of a Roaſting-Oven ſhould be ſo compoſed or conſtructed, that heat may not readily find its way *through it*; and we ſee likewiſe how neceſſary it is to manage the regiſters of blow-pipes and of air-chambers with proper care.

CHAPTER VI.

Of the uſefulneſs of ſmall Iron Ovens, and of the beſt methods of conſtructing them, and managing them—Reaſons why they have not ſucceeded in many caſes where they have been tried—Ovens may be uſed for other proceſſes of cookery beſides baking—Curious reſults of ſome attempts to boil meat in an oven—Explanation of theſe appearances—Conjectures reſpecting the origin of ſome national cuſtoms.

IN the Firſt Part of this Tenth Eſſay, I recommended ſmall iron ovens for cottagers, and neſts of ſmall ovens for the kitchens of large families; and I have had occaſion to know ſince, that ſeveral perſons have adopted them. I have likewiſe been made acquainted with the reſults of many of the trials that have been made of them, and with the complaints that have been brought againſt them. As I am more than ever of opinion that iron ovens will always be found uſeful when they are properly conſtructed and properly managed, I ſhall in this place add a few obſervations to what I have already publiſhed concerning them.

And in the firſt place I muſt obſerve, that a *ſmall* iron oven ſtands in need of a good door; that is to ſay, of a door well contrived for confining heat; and the ſmaller the oven is, ſo much the more neceſſary is it that the door ſhould be good.

The door muſt not only fit againſt the mouth of the oven with accuracy, but it muſt be compoſed of materials through which heat does not eaſily make its way.

An oven door conſtructed of a ſingle ſheet of plate iron, will not anſwer, however accurately it may be made to fit the oven, for the heat will find its way *through it*, and it will be carried off by the cold air of the atmoſphere, which comes into contact with the outſide of it. The bottom of the oven may be made hot by the fire under it; but the top and ſides of it cannot be properly heated, while there is a continual and great loſs of heat through its door. But an oven, to perform well, muſt be very equally heated in every part of it.

If the flame and ſmoke of the fire be made to ſurround an oven on every ſide, and if the fire be properly managed, there can be no difficulty in heating an iron oven equally, and of keeping it at an equal temperature, provided the loſs of heat by and *through* the door be prevented.

If the door be conſtructed of ſheet iron, it muſt either be made *double*, or it muſt be covered on the outſide with a pannel of wood. By a *double door*, I do not here mean *two doors*, but one door conſtructed of two ſheets or plates of iron, placed parallel to and at a certain diſtance from each other; and ſo conſtructed, that the air which is between the two plates may be ſhut up and confined. The two plates or ſheets of iron, of which the double door of an oven is made, muſt not touch each other, except at their edges (where they muſt join in order to their being faſtened together) for were they to lie one flat upon the other, the heat would paſs too rapidly through them, notwithſtanding there being two of them; but it is not neceſſary that they ſhould be farther aſunder than an inch, or an inch and an half. One of the plates may be quite flat, and the other a little convex. The end of the oven muſt be made quite flat, or level, ſo as to be perfectly cloſed by a flat ſurface placed *againſt* it. The door is that flat ſurface; and the greateſt care muſt be taken that it apply with accuracy, or touch the end of the oven in every part, when it is preſſed againſt it; for if any opening be left, eſpecially if it be near the top of the oven, the hot air in the oven will not fail to make its eſcape out of it.

It never ſhould be attempted to make the door of an oven or of a cloſed fire place fit, by cauſing it to *ſhut into a rabbet.* That is a very bad method; for beſides the difficulty of executing the work with any kind of accuracy, the expanſion of the metal with heat is very apt to derange the machinery, when the door is ſo conſtructed.

From what has been ſaid of the neceſſity of cauſing the door of an oven to fit with accuracy, it is evident that care muſt be uſed to place its hinges properly; and I have found, by experience, that ſuch a door is cloſed more accurately by two turn-buckles, placed at a proper diſtance from each other, than by a ſingle latch. I beg pardon for repeating what has already been ſaid elſewhere.

Of the Management of the Fire in heating an Iron Oven.

If a certain degree of attention is always neceſſary in the management of fire, there is certainly nothing on which we can beſtow our care that repays us ſo amply; and with regard to the trouble of managing a fire in a cloſed fire-place, it is really too inconſiderable to deſerve being mentioned.

Whenever a fire is made under an iron oven, in a cloſed fire-place, conſtructed on good principles, there is always *a very ſtrong draft* or preſſure of air into the fire place; and this circumſtance, which is unavoidable, renders it neceſſary to keep the fire-place door conſtantly cloſed, and to leave but a ſmall opening for the paſſage of the air through the aſh-pit regiſter. The fire-place too ſhould be made very ſmall, and particularly the bottom of it, or the grate on which the fuel burns.

If any of theſe precautions are neglected, the conſequences will be,—the rapid conſumption of the fuel,—the ſudden heating and burning of the bottom of the oven,—and the ſudden cooling of the oven as ſoon as the fire-place ceaſes to be filled with burning fuel.

It is a fact which ought never to be forgotten, "that of the air that forces its way into a cloſed "fire-place, that part only which comes into "actual contact with the burning fuel, and is de"compoſed by it in the proceſs of combuſtion,

" contributes any thing to the heat generated; " and that all the reſt of the air that finds its way " into and *through* a fire-place, is a thief, that ſteals " heat, and flies away with it up the chimney."

The draft occaſioned by a fire in a cloſed fire-place being INTO THE CHIMNEY and not into the fire, cold air is as much diſpoſed to ruſh in *over* the fire, as through it, and it violently forces its way into the hot fire-place by every aperture, even after all the fuel is conſumed, carrying the heat away with it up the chimney and into the atmoſphere. It even makes its way between the bars of the grate whenever they are not quite covered with burning fuel: hence it appears how neceſſary it is to make the grate of a cloſed fire-place ſmall, and to give to that part of the fire-place which is deſtined for holding the fuel, the form of an inverted truncated cone or pyramid, or elſe to make it very deep in proportion to its length and width.

But the prevention of the air from finding its way through the fire-place without coming into contact with the burning fuel, is not the only advantage that is derived from conſtructing cloſed fire-places in the manner here recommended; it ſerves alſo to increaſe the intenſity of the heat in that part of the fire-place which contains the fuel, which tends very powerfully to render the combuſtion of the fuel complete, and conſquently to augment the quantity of heat generated in that proceſs.

To prevent the bottom of the oven (or boiler) from being too much affected by this intenſe heat, nothing more is neceſſary than to make the fire-place *ſufficiently ſmall*, and to place it at a ſufficient diſtance below the bottom of the oven. It will be indiſpenſably neceſſary however with ſuch a (ſmall) fire-place, ſituated far below the bottom of an oven, to keep the fire-place door *well cloſed*, otherwiſe ſo much cold air will ruſh in *over the fire*, that it will be quite impoſſible to make the oven hot.

I have found by recent experiments, that a fire-place in the form of an oblong ſquare or priſm, ſix inches wide, nine inches long, and ſix inches deep, is ſufficient to heat an iron oven 18 inches wide, 24 inches long, and from 12 to 15 inches in height; and that the grate of this fire-place ſhould be placed about 12 inches below the bottom of the oven. More effectually to prevent the fire from operating with too much violence upon any one part of the bottom of the oven, the brick-work may be ſo ſloped outwards and upwards on every ſide from the top of the burning fuel to the extreme parts of the ſides and ends of the bottom of the oven, that the whole of the bottom of the oven may be expoſed to the direct rays from the fire.

In ſome caſes I have ſuffered the flame to paſs freely up both ſides of the oven to the top of it, and then cauſed it to deſcend by the end of the oven to the level of its bottom, or rather below it, and from thence to paſs off by an horizontal canal into the chimney; and in other caſes I have cauſed it to paſs backwards and forwards in horizontal canals by the ſides of the oven, before I permitted it to go off into the chimney. Either of theſe methods will do very well, provided the ſmoke be made to *deſcend* after it has left the top of the oven, till it reaches below the level of the bottom of it, before it is permitted to paſs off into the chimney; and provided the canal by which the ſmoke paſſes off be furniſhed with a damper.

In ſetting an oven proviſion ſhould be made, by leaving holes, to be ſtopped up with ſtoppers, for occaſionally cleaning out all the canals in which the ſmoke is made to circulate; and in order that theſe canals may not too often be choaked up with ſoot, they ſhould never be made leſs than two inches wide, even where they are very deep or broad; and where they are not more than four or five inches deep, they ſhould be from three to four inches wide, otherwiſe they will be very often choaked up with ſoot.

To clean out the flues of an Oven, Roaſter, or large fixed boiler, a ſtrong cylindrical bruſh may be uſed, which may have a flexible handle made of three or more iron wires, about $\frac{1}{8}$ or $\frac{1}{10}$ of an inch in diameter, twiſted together.

Holes cloſed with fit ſtoppers muſt of courſe be left in the brick-work for occaſionally cleaning out theſe flues.

If the iron door of an oven be made double, the outſide of it may with ſafety be japanned black or white, which will prevent its ruſting, and add much to the cleanlineſs and neatneſs of the appearance of the kitchen.

Theſe details may by ſome be thought unimportant and tireſome; but thoſe who know how much depends on minute details in the introduction of new mechanical improvements, will be diſpoſed to excuſe the prolixity of theſe deſcriptions. I wiſh I could make my writings palatable to the generality of readers, but that I fear is quite impoſſible. My ſubjects are too common and too humble to excite their curioſity, and will not bear the high ſeaſoning to which modern palates are accuſtomed.

A great diſadvantage under which I labour is, that of thoſe who *might* profit moſt from my writings, many *will not read*, and others *cannot*.

But to return to my ſubject. To ſave expence, ſmall ovens for poor families may be cloſed with flat ſtones, or with tiles; and the fire-place door for ſuch an oven, and its aſh-pit regiſter, may be made of common bricks placed edgewiſe, and made to ſlide againſt thoſe openings.

There is a circumſtance reſpecting the iron ovens I am deſcribing, which is both curious and important. The fire-place for an oven of the ſmalleſt ſize ſhould be nearly as capacious as one which is deſtined for heating a much larger oven; and I have found by repeated experiments, that a neſt of four ſmall ovens, ſet together, and heated by the ſame fire, will require but very little more fuel to heat them than would be neceſſary to heat one of them, were it ſet alone. An attentive conſideration of the manner in which the heat is applied—of the ſmallneſs of the quantity, in all caſes, that is applied to the heating of the contents of the oven—

and the much greater quantity that is expended in heating the fire-place and the flues, will enable us to account for this curious fact, in a manner that is perfectly philoſophical and ſatisfactory.

A cottage oven, 11 inches wide, 10 inches high, and 16 inches long, will require a fire-place five inches wide, five inches high, and ſeven inches long; and for *four* of theſe ovens, ſet together in a neſt, the fire-place need not be more than ſix inches wide, ſix inches high, and eight inches long.

I have in my houſe at Brompton two iron ovens, each 18 inches wide, 14 inches high, and 24 inches long, ſet one over the other, and heated by the ſame fire; and their fire-place is only ſix inches wide, ſix inches high, and nine inches long.

If the fire-place of an iron oven be properly conſtructed, and if the fire be properly managed, it is almoſt incredible how ſmall a quantity of fuel will anſwer for heating the oven, and for keeping it hot. But if the fire-place door be allowed to ſtand open, and a torrent of cold air be permitted to ruſh into the fire-place and through the flues, it will be found quite impoſſible to heat the oven properly, whatever may be the quantity of fuel conſumed under it; and neither the baking of bread, nor of pies, nor any other proceſs of cookery, can be performed in it in a ſuitable manner.

A very moderate ſhare indeed of ingenuity is required in the proper management of a fire in a cloſed fire-place, and very little attention; and as it requires no bodily exertion, but ſaves labour, and expence, and anxiety; and as moreover it is an intereſting and amuſing occupation, attended by no diſguſting circumſtance, and productive of none but pleaſing, agreeable, and uſeful conſequences; we may, I think, venture to hope, that thoſe prejudices which prevent the introduction of theſe improvements, will in time be removed.

It is not obſtinacy, it is that *apathy* which follows a total corruption of taſte and morals, that is an *incurable* evil;—for that, alas! there is no remedy, but calamity and extermination.

Ovens may be uſed in boiling and ſtewing, and alſo in warming rooms.

There are ſo many different ways in which the heat neceſſary in preparing food may be applied, that it would not be ſurpriſing if one ſhould ſometimes be embarraſſed in the choice of them; and I am not without apprehenſion, that I may embarraſs my readers by deſcribing and recommending ſo many of them. The fact is, they all have their different kinds of merit, and in the choice of them regard muſt always be had to the exiſting circumſtances.

Deſirous of contriving a fire-place on as ſimple a conſtruction as poſſible, that ſhould ſerve at the ſame time for heating a room, and for the performance of all the common proceſſes of cookery for a ſmall family, and which moreover ſhould not be expenſive, nor require much attendance, I cauſed four ſmall iron ovens to be ſet in the opening of a common chimney fire-place. Thoſe ovens, which were conſtructed of ſheet iron, and were furniſhed with doors of the ſame ſheet iron, each covered with a pannel of wood to confine the heat, were 16 inches long, 11 inches wide, and 10 inches high each; and they were ſet in brick-work in ſuch a manner, that the fronts of the doors of the ovens being even with the ſide of the room, the original opening of the chimney fire-place, which was large, was completely filled up. Theſe ovens were all heated by one ſmall fire, the cloſed fire-place being ſituated about 12 inches below the level of the bottoms of the two lowermoſt ovens, and perpendicularly under the diviſion between them, and the paſſage into the fire-place was cloſed by a fit ſtopper.

From this deſcription, it will not be difficult for any perſon who has peruſed the preceding chapters of this eſſay, to form a perfect idea of this arrangement; and it is equally eaſy to perceive, that had not the open chimney fire-place, in which theſe four ovens were ſet, been very large, I ſhould have been under the neceſſity of enlarging it, or at leaſt of raiſing its mantle, in order to have been able to introduce theſe ovens, and ſet them at proper diſtances from each other.

I ſhall now proceed to give an account of the experiments that were made with this fire-place.

My firſt attempt was to warm the room by means of it. A ſmall fire being made in its cloſed fire-place, its oven doors were all ſet wide open, and the room, though by no means ſmall, ſoon became very warm. This warming apparatus was now, to all intents and purpoſes, a German ſtove. By ſhutting two of the oven doors, the heat of the room was ſenſibly diminiſhed; and by leaving only one of them open, it was found that a moderate degree of warmth might be kept up, even in cold weather.

As no perſon in this country would be ſatisfied with any fire-place, if in its arrangement proviſion were not made for boiling a tea-kettle, I cauſed a very broad ſhallow tea-kettle, with a bottom perfectly flat, to be conſtructed of common tin, and filling it with cold water, placed it in one of the two lower ovens, and ſhut the oven door. Although the fire under the ovens was but ſmall, it burnt very bright, and the water in the tea-kettle was ſoon made to boil.

I was not ſurprized that the water boiled in a ſhort time, for it was what I expected; but on removing the tea-kettle I obſerved an appearance which did ſurprize me, and which indicated a degree of heat in the oven which I had no idea of finding there. The handle of the tea-kettle reſembled very much, in form, the handle of a common tea-kettle, but, like the reſt of the kettle, was conſtructed of tin, or, to ſpeak more properly, of tinned ſheet iron.

On removing the kettle from the oven I found that the tin on its handle had been melted, and had fallen down in drops, which reſted on the body of the kettle below, where they had congealed, having been cooled by the water in the kettle.

This diſcovery convinced me that I ſhould not fail of obtaining in theſe ovens any degree of heat that could poſſibly be wanted in any culinary proceſs whatever: it ſhowed me likewiſe that degrees of temperature, much higher than that of boiling water, may exiſt in a cloſed oven in which water is boiling; and it ſeemed to indicate, that all the different culinary proceſſes of boiling, ſtewing, roaſting, and baking, might be carried on at the ſame time in one and the ſame oven. Subſequent experiments have ſince confirmed all theſe indications, and have put the facts beyond all doubt. Theſe facts are certainly curious, and the knowledge of them may lead to uſeful improvements; for they may enable us to ſimplify very much the implements uſed in cookery.

Having found that I could boil water in my ſmall ovens, my next attempt was to boil meat in them. I put about three pounds of beef, in one compact lump, into an earthen pot, and filling the pot to within about two inches of its brim with cold water, I ſet it in one of the lower ovens, ſhutting the door of the oven, and keeping up a ſmall ſteady fire in the fire-place. In about two hours and three-quarters the meat was found to be ſufficiently boiled; and all thoſe who partook of it (and they were not fewer than nine or ten perſons) agreed in thinking it perfectly good and uncommonly ſavory. On my guard againſt the illuſions which frequently are produced by novelty, I ſhould have had doubts reſpecting the reality of thoſe *ſuperior qualities* aſcribed to this boiled beef, had not an uncommon appearance in the water in which it had been boiled attracted my attention. This water, after the meat had been boiled in it, appeared to be nearly as tranſparent and as colourleſs as when it was brought from the pump. It immediately occurred to me, that this effect could be owing to nothing elſe but to the ſtate of perfect quiet in which the water muſt neceſſarily have been during the greater part of the time it remained in the oven; and to determine whether this was really the caſe, or not, I made the following deciſive experiment;

Having provided two equal pieces of beef from the ſame carcaſe, I put them into two ſtew-pans of nearly the ſame form and dimenſions; one of them which had a cover, being conſtructed of earthen ware, while the other, which had no cover, was made of copper.

Into theſe ſtew-pans I now put equal quantities of water, with this difference however, that while the water put into the copper ſtew-pan was cold, that put into the other was boiling hot. A ſmall fire being now made in the fire-place, theſe two ſtew-pans, with their contents, were introduced into the two lower ovens. The earthen ſtew-pan was ſet down upon a ten-inch tile, which had previouſly been placed in the oven, to ſerve as a ſupport for it, in order to prevent the bottom of the ſtew-pan from coming into immediate contact with the bottom of the oven, and the door of that oven was ſhut; but the copper ſtew-pan was ſet down immediately on the bottom of its oven, and the door of that oven was left open during the whole time the experiment laſted.

At the end of three hours, the ſtew-pans were taken out of the ovens, and their contents were examined. The appearances were juſt what I expected to find them. The meat in each of the ſtew-pans was ſufficiently boiled, but there was certainly a very ſtriking difference in the appearance of the liquor remaining in the two utenſils; and if I was not much miſtaken, there was a ſenſible difference in the taſte of the two pieces of meat; that boiled in the earthen ſtew-pan being the moſt juicy and *moſt* ſavory. The water *remaining in* this veſſel—and little of it had evaporated—was ſtill very tranſparent and colourleſs, and nearly taſteleſs, while the liquor in the copper ſtew-pan was found to be a rich meat-broth.

The reſult of this experiment recalled very forceably to my recollection a diſpute I had had ſeveral years before, in Germany, with the cook of a friend of mine, who, at my recommendation, had altered his kitchen fire-place; in which diſpute I now ſaw I was in the wrong, and ſeeing it, felt a deſire more eaſy to be conceived than to be deſcribed, to make an apology to an innocent perſon whom I had unjuſtly ſuſpected of wilful miſrepreſentation. This woman (for it was a female cook) on being repeatedly reprimanded for ſending to table a kind of ſoup of inferior quality, which, before the kitchen was altered, ſhe had always been famous for making in the higheſt perfection, perſiſted in declaring that ſhe could not make the ſame good rich ſoup in the new faſhioned boilers (fitted up in cloſed fire-places, and heated by ſmall fires) as ſhe uſed to make in the old boilers, ſet down upon the hearth before a great roaring wood fire.

The woman was perfectly in the right. To make a rich meat ſoup, the juices muſt be waſhed out of the meat, and intimately mixed with the water; and this waſhing out in boiling muſt be greatly facilitated and expedited by the continual and rapid motion into which the contents of a boiler are neceſſarily thrown when heat is applied to one ſide of it only, eſpecially when that heat is ſufficiently intenſe to keep the liquid continually boiling with vehemence. I ought, no doubt, to have foreſeen this; but how difficult is it to foreſee any thing!—It is much eaſier to explain than to predict.

If it be admitted that fluids in receiving and giving of heat are neceſſarily thrown into internal motions, in conſequence of the changes of ſpecific gravity in the particles of the fluid, occaſioned by the alteration of their temperatures, we ſhall be able to account, in a manner perfectly ſatisfactory, not only for the appearances obſerved in the experiments

riments above mentioned, and for the ſuperior richneſs of the ſoup made by the Bavarian cook in her boiler, but alſo for ſeveral other curious facts.

When the copper ſtew-pan, containing cold water and a piece of meat, was put into an iron oven, heated by a fire ſituated below it, as the bottom of the oven on which the ſtew-pan was placed was very hot, the heat paſſing rapidly through the flat bottom of this metallic utenſil, communicated heat to the lower ſtratum of the water, which, becoming ſpecifically lighter on being thus heated was crouded out of its place, and forced upwards, by the ſuperincumbent colder and conſequently heavier liquid:—This neceſſarily occaſioned a motion in every part of the fluid, and this motion muſt have been rapid in proportion as the communication of heat was rapid; and it is evident that it could never ceaſe, unleſs all the water in the ſtew-pan could have acquired and preſerved an equal and a permanent temperature, which, under the exiſting circumſtances, was impoſſible; for as the door of the oven was left open, the upper ſurface of the water was continually cooled by giving of heat to the cold atmoſphere, which, ruſhing into the oven, came into contact with it; and as ſoon as the water was made boiling hot, an internal motion of another kind was produced in it, in conſequence of the formation and eſcape of the ſteam; which laſt motion was likewiſe rapid, and violent in proportion to the rapidity of the communication of heat. Hence we ſee that the water in the copper ſtew-pan muſt have been in a ſtate of continual agitation from the time it went into the oven till it came out of it; and the ſtate in which this liquid was found at the end of the experiment, was preciſely that which might have been expected, on a ſuppoſition that theſe motions would take place. Let us now ſee what, agreeably to our aſſumed principles, ought to have taken place in the other ſtew-pan.

In this caſe its contents having been nearly boiling hot when the ſtew-pan was put into the oven, and the door of the oven having been kept cloſed, and the ſtew-pan covered with its earthen cover, and the ſtew-pan being moreover earthenware, which ſubſtance is a very bad conductor of heat, and being placed, not immediately on the bottom of the oven, but on a thick tile, every circumſtance was highly favourable, not only for keeping up the equal heat of the water, but alſo for preventing it from receiving additional heat ſo rapidly as to agitate it by boiling. There is therefore every reaſon to think that the water remained at reſt, or nearly ſo, during the whole time it was in the oven: and the tranſparency of this fluid, at the end of the experiment, indicated that little or none of the juices of the meat had been mixed with it.

When the Bavarian cook made ſoup in her own way, the materials (the meat and water) were put into a tall cylindrical boiler, and this boiler was ſet down upon the hearth *againſt* a wood fire, in ſuch a manner that the heat was applied to *one ſide only* of the boiler, while the other ſides of it were expoſed to the cold air of the atmoſphere; conſequently the communication of the heat to the water produced in it a rapid circulatory motion; and when the water boiled, this motion became ſtill more violent. And this proceſs being carried on for a conſiderable length of time, the juices of the meat were ſo completely waſhed out of it, that what remained of it were merely taſteleſs fibres: but when the ingredients for this meat ſoup, taken in the ſame proportions, were cooked during the ſame length of time in a boiler ſet in a cloſed fire-place, and heated by a ſmall equal fire; this moderate heat being applied to the boiler on every ſide at the ſame time, while the loſs of heat at the ſurface of the liquid was effectually prevented by the double cover of the boiler, the internal motions in the water, occaſioned by its receiving heat, were not only very gentle, but they were ſo divided into a vaſt number of ſeparate aſcending and deſcending ſmall currents, that the mechanical effects of their impulſe on the meat could hardly be ſenſible; and as the fire was ſo regulated that the boiling was never allowed to be at all vehement (the liquid being merely kept gently ſimmering) after the contents of the boiler were once brought to the temperature of boiling, the currents occaſioned by the heating ceaſed of courſe, and the liquid remained nearly in a ſtate of reſt during the remainder of the time that the proceſs of cooking was continued; the ſoup was found to be of a very inferior quality, but on the other hand the meat was uncommonly juicy and ſavory.

Theſe minute inveſtigations may perhaps be tireſome to ſome readers; but thoſe who feel the importance of the ſubject, and perceive the infinite advantages to the human ſpecies that might be derived from a more intimate knowledge of the *ſcience* of preparing food, will be diſpoſed to engage with cheerfulneſs in theſe truly intereſting and entertaining reſearches: and ſuch readers, and ſuch only, will perceive that it has not been without deſign, that in chapters devoted to the explanation of ſubjects the moſt humble, I have frequently introduced obſtruſe philoſophical reſearches, and the reſults of profound meditation.

I am not unacquainted with the manners of the age. I have lived much in the world, and have ſtudied mankind attentively; and am fully aware of all the difficulties I have to encounter in the purſuit of the great object to which I have devoted myſelf. I am even ſenſible, fully ſenſible, of the dangers to which I expoſe myſelf.—In this ſelfiſh and ſuſpicious age it is hardly poſſible that juſtice ſhould be done to the purity of my motives; and in the preſent ſtate of ſociety, when ſo few who have leiſure can bring themſelves to take the trouble to read any thing except it be for mere amuſement, I can hardly expect to engage attention.

tion. I may write; but what will writing avail if nobody will read. My bookſeller, indeed, will not be ruined, as long as it ſhall continue to be *faſhionable* to have *fine libraries*. But my object will not be attained, unleſs my writings are read; and the importance of the ſubjects of my inveſtigations are felt.

Perſons who have been ſatiated with indulgences and luxuries of every kind, are ſometimes tempted by the novelty of an untried purſuit. My beſt endeavours ſhall not be wanting to give to the objects I recommend, not only all the alluring charms of novelty, but alſo the power of procuring a pleaſure as new, perhaps, as it is pure and laſting.

How might I exult, could I but ſucceed ſo far as to make it *faſhionable* for the rich to take the trouble to *chuſe for themſelves* thoſe enjoyments which their money can command, inſtead of being the dupes of thoſe tyrants, who, in the garb of ſubmiſſive fawning ſlaves, not only plunder them in the moſt diſgraceful manner, but render them at the ſame time perfectly ridiculous, and fit for that deſtruction which is always near at hand, when good taſte has been driven quite off the ſtage.

When I ſee, in the capital of a great country, in the midſt of ſummer, a coachman ſitting on a coach-box, dreſſed in a thick heavy great coat with ſixteen capes, I am not ſurprized to find the coach door ſurrounded by a groupe of naked beggars.

We ſhould tremble at ſuch appearances, did not the ſhortneſs of life, and the extreme levity of the human character, render us inſenſible to dangers while at any diſtance; however great, and impending, and inevitable they may be.

But to return from this digreſſion.

It is frequently uſeful, and is always amuſing, to trace the differences in the cuſtoms and uſages of different countries to their cauſes. The French have for ages been remarkable for their fondneſs for ſoups, and for their ſkill in preparing them: now as national habits of this kind muſt neceſſarily originate at a very early period of ſociety, and muſt depend on peculiar local circumſtances, may not the prevalence of the cuſtom of eating ſoup in France be aſcribed to the open chimney fire-places and wood-fires, which have ever been common in that country?

It is certain that in the infancy of ſociety, before the arts had made any conſiderable progreſs, families cooked their victuals by the ſame fire which warmed them. Kitchens then were not known; and the utenſils uſed in cooking were extremely ſimple, an earthen pot perhaps ſet down before the fire. We have juſt ſeen, that with ſuch an apparatus, ſoups of the very beſt qualities would naturally be produced; and it is not ſurprizing, that a whole nation ſhould acquire a fondneſs for a ſpecies of food, not only excellent in its kind, but cheap, nutritious, and wholeſome, and eaſily prepared.

Had coals been the fuel uſed in France, it is not likely that ſoups would have been ſo generally adopted in that country; for a common coal fire is not favourable for making good ſoups; although with a little management the very beſt ſoups may be made, and every other proceſs of cookery be performed, *in the higheſt perfection*, with any kind of fuel.

When the *ſcience* of cookery is once well underſtood, or an intimate knowledge is acquired of the preciſe nature of thoſe chemical and mechanical changes which are produced in the various culinary proceſſes, we may then, and not till then, take meaſures with certainty for improving the *art* of preparing food. Experience, unaſſiſted by ſcience, may lead, and frequently does lead to uſeful improvements; but the progreſs of ſuch improvement is not only ſlow, but vaciliating, uncertain, and very unſatisfactory. On that account no doubt, it is, that men of ſcience have in all ages been reſpected as valuable members of ſociety.

THE END OF THE
SECOND PART OF THE TENTH ESSAY.

Fig. 14.

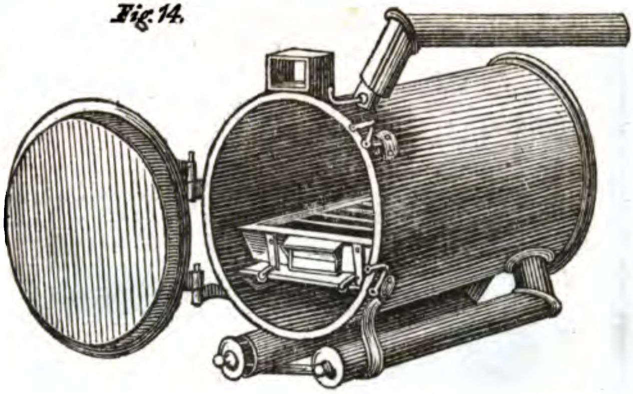

Fig. 15.

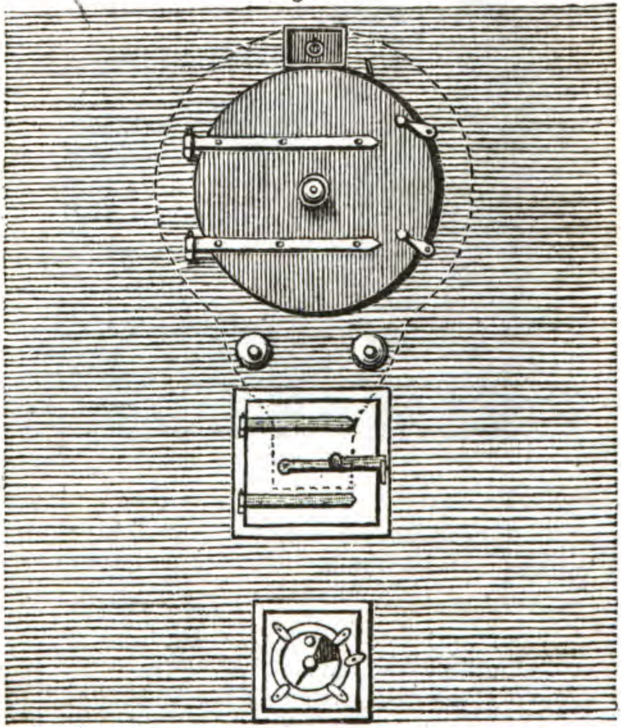

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Fig. 16.

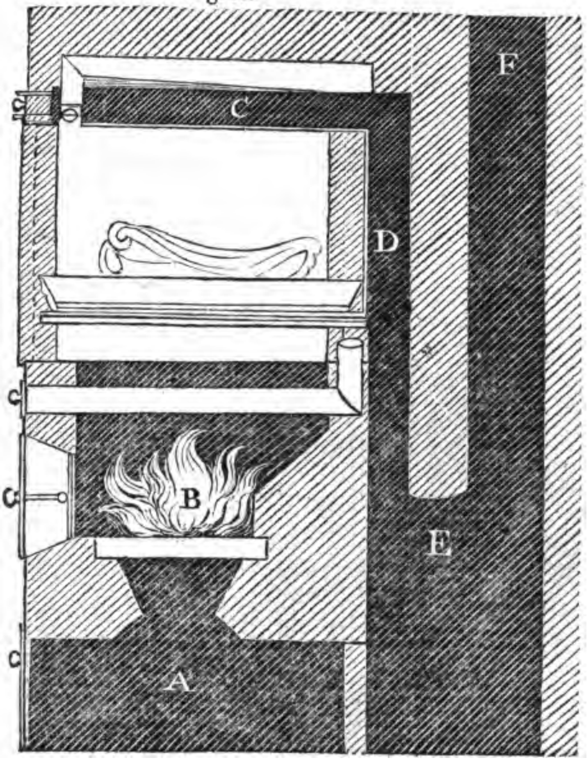

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Fig. 17

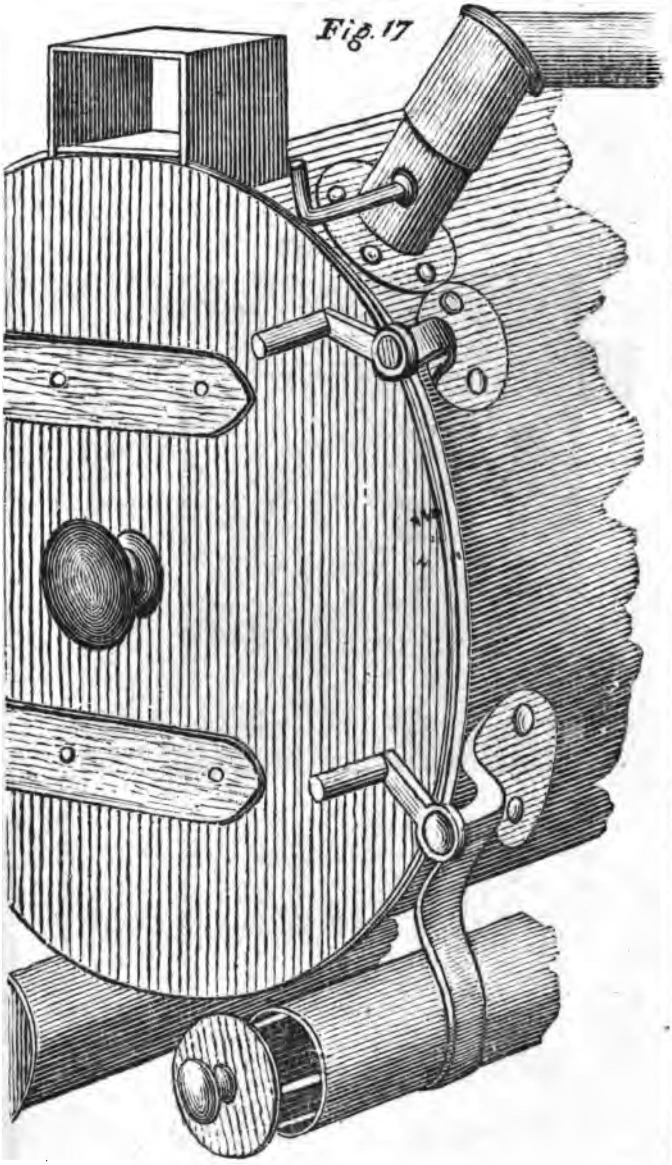

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Fig. 18.

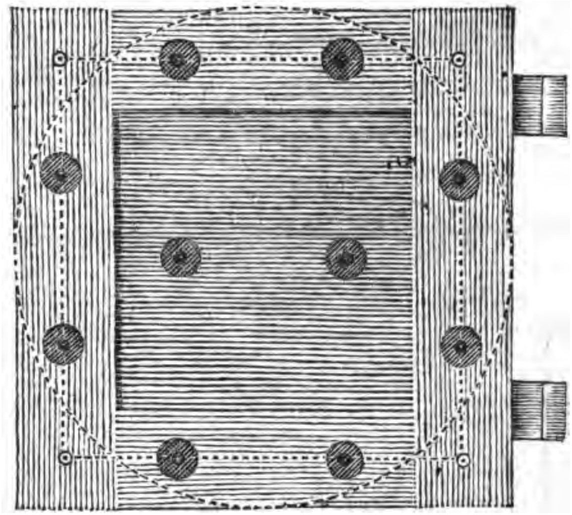

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Fig. 19

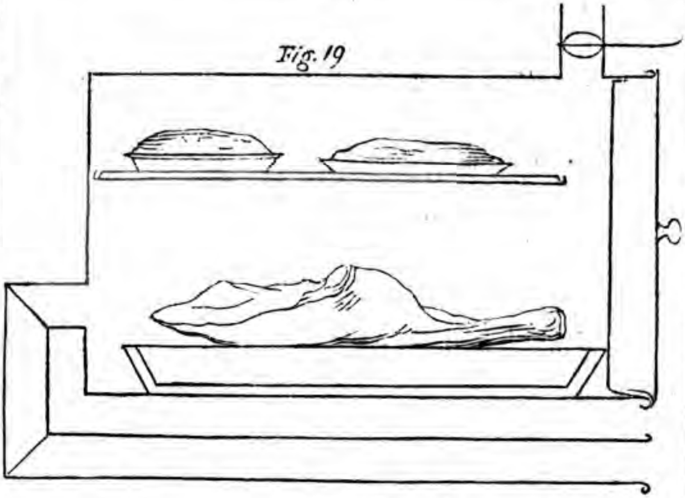

Fig. 20

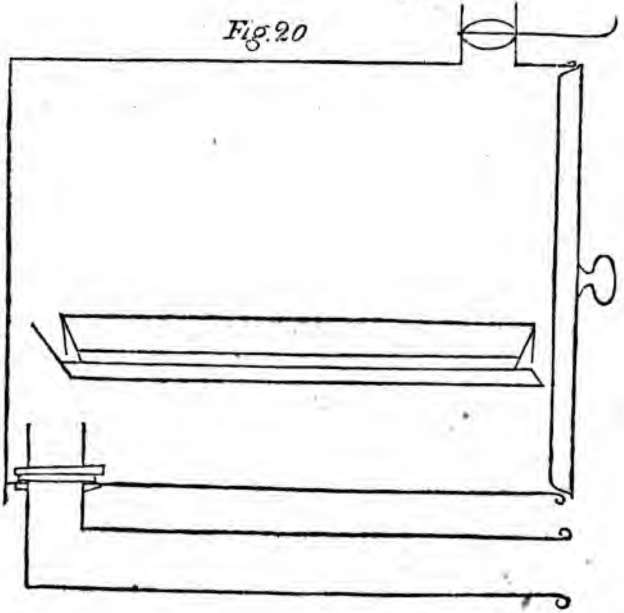

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Fig 21

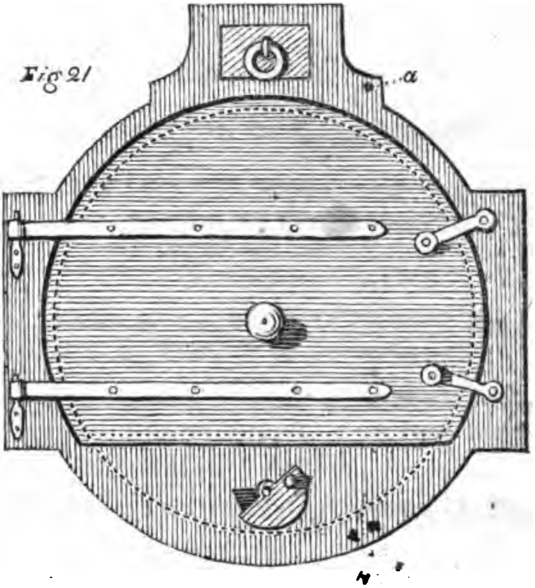
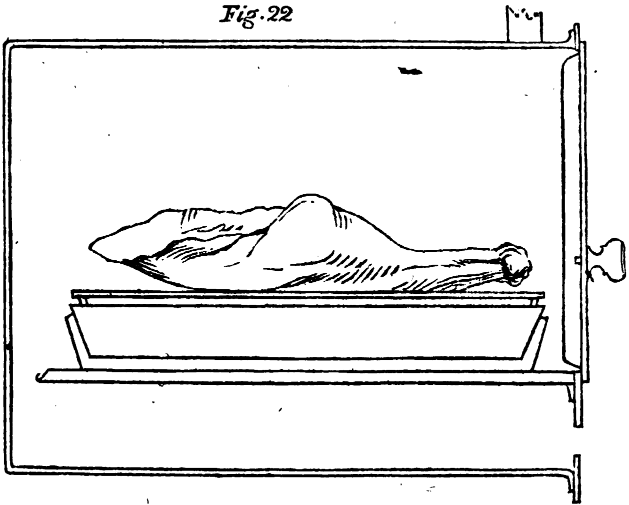


Fig. 22



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THAT MOST USEFUL ART.

ESSAY X.—PART III.

CHAP. VII.

Of the Conſtruction of Boilers, Stew-pans, &c.—Choice of the Material for Conſtructing Kitchen Utenſils—Objections to copper—Iron much leſs unwholeſome—Of the attempts that have been made in different countries to cover the ſurface of iron boilers with an enamel—Of earthen ware glazed with ſalt—Stew-pans and ſauce-pans of thdt ſubſtance recommended—Kitchen utenſils of earthen ware may be covered and protected by an armour of ſheet-copper—Wedgewood's ware, unglazed, would anſwer very well for kitchen utenſils—Directions for conſtructing ſtew-pans and ſauce-pans of copper in ſuch a manner as to make them more durable, and more eaſy to be kept clean—Theſe utenſils are frequently corroded and deſtroyed by the operation of what has been called the Galvanic influence—Of the Conſtruction of Covers for kitchen boilers, ſtew-pans, &c.

THE *choice of the material* to be uſed in conſtructing kitchen boilers, ſtew-pans, &c. is a matter of ſo much importance, that I cannot paſs it over in ſilence; though I am very ſenſible that all I can offer on the ſubject will not be ſufficient to remove entirely the various difficulties I ſhall be obliged to point out.

The objects principally to be had in view, in the choice of materials to be uſed in the conſtruction of kitchen utenſils are, wholeſomeneſs—cheapneſs—and durability. The material moſt commonly uſed for conſtructing kitchen boilers and ſauce-pans is *copper*; but the poiſonous qualities of that metal, and the facility with which it is corroded and diſſolved by the acids which abound in thoſe ſubſtances that are uſed as food, has long been known and lamented; and numerous attempts have been made to prevent its deleterious effects, by covering its ſurface with tin and with other metallic ſubſtances, and with various kinds of varniſh and enamel; but none of theſe contrivances have completely anſwered the purpoſe for which they were deſigned.

The method which has been found to be moſt effectual is, to keep the copper utenſils well tinned, or to tin them afreſh as often as the copper begins to appear, and this is what is now commonly practiſed; but ſtill it were to be wiſhed that ſome good ſubſtitute might be found for that unwholeſome metal.

Iron has often been propoſed; and though it is more liable to be corroded even than copper, yet as the ruſt (oxide) of iron is not poiſonous, though it changes the colour of ſome kinds of food that are cooked in it, and in ſome caſes communicates an aſtringent taſte to them, it is not thought to make food unwholeſome.

There is, however, one precaution, by means of which the diſagreeable effects produced by this metal on food, that is prepared in utenſils conſtructed of it, may be very much diminiſhed, and indeed in moſt caſes almoſt entirely prevented, eſpecially when the utenſil is made of *caſt iron*. If, inſtead of ſcouring the inſide of iron boilers and ſtew-pans with ſand, and keeping them bright, which notable houſewives are apt to do, in order that their kitchen furniture may appear neat and clean, they be ſimply waſhed and rinſed out with warm water, and wiped with a ſoft diſh-cloth or towel, the ſurface of the metal will ſoon become covered with a thin cruſt or coating of a dark brown colour, reſembling enamel; which covering, if it be ſuffered to remain, and to conſolidate, will at laſt become ſo hard as to take a very good poliſh, and will ſerve very efficaciouſly to defend the ſurface of the metal from farther corroſion, and conſequently to prevent the food from acquiring that taſte and colour which iron is apt to impart to it.

The proceſs by which this covering is gradually formed, is ſimilar to that by which ſome gunſmiths brown the barrels of fowling-pieces, and could no doubt be greatly expedited by the ſame means which they employ for that purpoſe: the object had in view is likewiſe the ſame in both caſes, namely, by cauſing a hard and impenetrable covering of ruſt to be formed on the ſurface of the iron, to defend it from a contact with thoſe ſubſtances which are capable of diſſolving or corroding it, or in other words, to prevent the farther progreſs of the ruſt.

For iron utenſils deſigned merely for *frying*, or cooking in fat, there is an eaſy and a very effectual precaution that may be taken for preventing ruſt. It is to avoid putting hot-water into them, and above all to avoid boiling, or even heating water in them. They may occaſionally be waſhed out with warm water; but as often as this is done, great care muſt be taken to wipe them perfectly dry with a dry cloth before they are put away.

The effects produced by this management may be explained in a ſatisfactory manner. As fatty or oily ſubſtances cannot communicate oxigen to iron, (with which that metal muſt unite in order that ruſt may be formed,) and as they prevent the approach of other ſubſtances which could furniſh it (air, water, acids, &c.) as long as the ſurface of the iron is completely covered by them, it is evident that no ruſt can be formed. But boiling hot-water, and more eſpecially water heated and actually made to boil in ſuch a veſſel, could not fail to diſlodge the fat from the ſurface of the metal, and leave it naked and expoſed to every thing that is capable of corroding it.

Kitchen utenſils made of iron may be tinned on the inſide to preſerve them from ruſt; and this is frequently done.—But even tin, though it be much leſs liable to be diſſolved by thoſe ſubſtances which are uſed in cookery than iron or copper, yet it is ſometimes ſenſibly corroded by them, and conſequently is taken into the ſtomach with our food.

What its effects may be on the human body, when taken in very ſmall quantities, I cannot pretend to determine.—In large doſes it is well known to be a fatal poiſon.

That the tin with which the inſides of kitchen-boilers and ſtew-pans are covered, is actually corroded in many of the proceſſes of cookery, is rendered highly probable by the very ſhort time that ſuch a coating laſts, when the utenſil is in daily uſe; but I had, not long ſince, a ſtill more ſtriking proof of that fact. Learning by accident from my cook, that a diſh of which I am very found, (*ſtewed pears,* which I frequently eat with bread and milk for my ſupper,) require three hours boiling, it occurred to me, that as this proceſs was performed in a copper ſtew-pan, tinned, and as it laſted ſo long a time, the tin might perhaps be attacked, and ſome part of it diſſolved by the acid of the pears, or by that of the ſugar which was mixed with them. In order that I might be able to enjoy my favourite diſh, free from all apprehenſions of being poiſoned, I ordered it to be always prepared in future in a ſtew-pan of porcelain: but ſeveral of theſe veſſels having been deſtroyed in a ſhort time by the fire, in this proceſs, I found myſelf obliged to abandon this ſcheme on account of theſe frequent accidents: and I now had recourſe to my Roaſter.

The pears, being previouſly cut in quarters, and freed from their ſkins, ſeeds, and cores, were put with a ſufficient quantity of water and ſugar, into a ſhallow glaſs baſin fitted with a glaſs cover, and this baſin being placed upon a brick, was put into the Roaſter, and a ſmall fire being made under it, the water in the baſin was ſoon brought to boil, and in leſs than three hours the pears were found to be ſufficiently done.

When they were ſerved up, I obſerved that their colour was different from what it had always been before; and enquiring into the cauſe of it, I was let into a ſecret which explained the matter completely. The cook informed me, that it was abſolutely impoſſible to give *a beautiful red colour* to ſtewed pears without ſome metal, and that their colour would not have been ſo fine as it was when they were cooked in porcelain, had not the precaution been taken *to boil a pewter ſpoon with them.* The Reader can eaſily imagine how much I was ſurprized at receiving this unexpected information.

This ingenious contrivance is ſimilar to one ſometimes uſed in this country—that of boiling *halfpence* with greens to give them a fine colour.

Several years ago a variety of attempts were made in Sweden to improve cooking utenſils made of iron, by covering them on the inſide with a kind of enamel, to protect them from ruſt; and ſince that time a conſiderable manufacture of caſt-iron boilers and ſtew-pans, covered within with white enamel, was eſtabliſhed by Count Heinitz, on his eſtate in Sileſia; but this ſcheme has not ſucceeded intirely, owing to the difficulty of finding an enamel capable of uniting with iron, the expanſion of which with heat ſhall be ſo nearly equal to the expanſion of iron, as not be liable to crack and fly off upon being ſuddenly expoſed to heat and to cold; and even were it poſſible to compoſe an enamel that would withſtand the effects of the heat and the cold, and the blows to which it would be expoſed in the buſineſs of the kitchen, there would ſtill remain a very important point to be aſcertained, which is, whether the matter of which the enamel is compoſed *is not itſelf of a poiſonous nature*, and whether there is not reaſon to apprehend that it might communicate its deleterious qualities to the food?

Lead is an eſſential ingredient in moſt, if not all enamels, and as its effects are known to be extremely pernicious to health, under all its various forms, when taken internally, it would be highly neceſſary to aſcertain, by the moſt rigid experimental inveſtigation, whether the enamel of kitchen utenſils contains any lead, or other noxious metals or unwholeſome ſubſtance; and if this be the caſe, whether ſuch poiſonous ſubſtance be liable to be corroded and diſſolved, or mixed in any other manner with the food.

It is poſſible that a poiſonous ſubſtance may be ſo fixed, on being mixed and united with other ſubſtances, as to render it perfectly inſoluble, and conſequently perfectly inert and harmleſs; but ſtill the fact ought to be well aſcertained before it is admitted.

A large proportion of the calx of lead enters into the compoſition of flint glaſs, yet it is not probable that flint glaſs ever communicates any thing poiſonous to food or drink that is kept in it. But on the other hand there is reaſon to conclude, that the glazing of common pottery, which is likewiſe compoſed in part of calx of lead, is not equally ſafe, when earthen veſſels covered with it are uſed as implements of cookery.—In ſome countries the uſe of ſuch veſſels in the proceſſes of boiling and ſtewing is forbidden by the laws, under ſevere penalties; and in this country it is not cuſtomary to uſe earthen veſſels, ſo glazed, for preſerving pickles, and other ſubſtances deſigned for the uſe of the table, which contain ſtrong acids.

The beſt glazing for earthen veſſels that are to be uſed in preparing or preſerving food, is moſt undoubtedly made with common ſalt; as this glazing (which appears to be merely the beginning of a vitrification of the earth at the ſurface of the veſſel) is not only very hard and durable, but it is alſo perfectly inſoluble in all the acids and other ſubſtances in common uſe in kitchens; and contains nothing poiſonous or unwholeſome.

A large proportion of lead enters into the compoſition of pewter; but it has lately been proved by many ingenious experiments made to aſcertain the fact, that the lead, united to tin, and the other metallic ſubſtances that are uſed in compoſing pewter, is incomparably leſs liable to be diſſolved by acids, and conſequently much leſs unwholeſome, than when it is pure or unmixed with other metals. This fact is very important, as it tends to remove all apprehenſion reſpecting the unwholeſomeneſs of a very uſeful compound metal, which from its cheapneſs, as well as on account of its durability, renders it peculiarly well adapted for many domeſtic uſes. It would not however be adviſeable to boil or ſtew any kind of food, eſpecially ſuch as contain acids, in pewter veſſels; nor ſhould acid ſubſtances ever be ſuffered to remain long in them.

The beſt, or at leaſt the moſt wholeſome material for ſtew-pans and ſauce-pans is, undoubtedly, earthen ware, glazed with ſalt*. Several manufactories of this kind of pottery have lately been eſtabliſhed in this country, and one in particular in the King's Road, at Chelſea, which belonged to the late Mrs. Hempel, which is, I believe, now carried on by her ſons. The principal reaſon why this article has not long ſince found its way into common uſe, is, no doubt, the brittleneſs of earthen ware, and its being ſo liable to crack on being ſuddenly expoſed to heat, or to cold; for, excepting this imperfection, it has every thing to recommend it. It is perfectly wholeſome (when glazed with ſalt); and is kept clean with little trouble; and things cooked in it are much leſs liable to be burnt to the ſides of the veſſel, and ſpoilt, than when the utenſil is formed of a metallic ſubſtance.

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* Nothing is more pernicious than the glazing of common coarſe earthen ware. There is no objection to *unglazed* earthen ware, but its being apt to imbibe moiſture, which renders it difficult to be kept clean. I have lately ſeen ſome kitchen utenſils of very fine, compact, unglazed earthen ware, bought at Mr. Wedgewood's manufactory, which I thought very good. They were made thin, and ſeemed to ſtand the fire very well; and as their ſurface was very ſmooth, they were eaſily kept clean. I wiſh that the intelligent gentlemen, who direct that noble manufactory, would turn their attention to the improvement

There is a very great difference in earthen ware, in reſpect to its power of withſtanding the heat, without injury, on being ſuddenly expoſed to the action of a fire; ſome kinds of it being much leſs liable to crack, and fly, when ſo expoſed, than others; and in order to take meaſures with certainty for diminiſhing this imperfection, we have only to conſider the cauſes from which it proceeds. Now, it is quite certain, that the cracking of an earthen veſſel on its being put over a fire, is owing to *two* circumſtances—the brittleneſs of the ſubſtance

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ment of an article ſo nearly connected with the health, comfort, and peace of mind, of a great portion of ſociety. Stewpans of this material, ſuſpended in a cylindrical armour of ſheet iron, would be admirably calculated for the regiſter ſtoves I ſhall recommend. Some of theſe ſtoves may be ſeen in the Great Kitchen of the Royal Inſtitution.

ſtance—and the difficulty or ſlowneſs with which heat paſſes through it; for it is evident, that neither of theſe circumſtances, alone, or acting ſingly, would be capable of producing the effect.

As heat expands all ſolid bodies, if one ſide of a veſſel, compoſed of a brittle ſubſtance, be ſuddenly heated, and *expanded*, it muſt crack, or rather, it muſt cauſe the other ſurface to crack, unleſs the heat can make its way through the ſolid ſubſtance of the veſſel, and heat and expand that other ſurface ſo expeditiouſly as to prevent that accident. Now as heat paſſes *through* a veſſel which is thin, ſooner than through one (compoſed of the ſame material) which is thicker, it is evident that the *thinner* an earthen veſſel for cooking is made, the leſs liable will it be to receive injury on being expoſed to ſudden heat or cold.

I mention ſudden *cold* as being dangerous, and it is eaſy to ſee why it muſt be equally ſo with ſudden heat. If a brittle veſſel be (by ſlow degrees) made very hot, if the heat be equally diſtributed throughout the whole of its ſubſtance, this heat, however intenſe it may be, will have no tendency whatever to cauſe the veſſel to crack; for the expanſion being equal at the two oppoſite ſurfaces, the *tenſion* at thoſe ſurfaces will be equal alſo; but if cold water be ſuddenly poured into a veſſel ſo heated, its internal ſurface will be ſuddenly cooled, and as ſuddenly *contracted*; and as the external ſurface cannot contract, being forceably kept in a ſtate of expanſion by the heat, the inſide ſurface muſt neceſſarily crack, in conſequence of its contraction, and this fracture will make its way immediately through the whole ſolid ſubſtance of the veſſel from the inſide to the outſide ſurface.

Sudden HEAT applied to one ſide, or ſurface, of a brittle veſſel cauſes the *oppoſite* ſide of it to crack; but ſudden COLD *cauſes the ſide to crack to which the cold is applied.*

By forming diſtinct ideas of what happens in theſe two caſes, every thing relative to the ſubject under conſideration will be rendered perfectly clear and intelligible.

The *form* of a veſſel has a conſiderable effect in rendering it more or leſs liable to be cracked and deſtroyed by ſudden heat or cold. All flat ſurfaces, ſharp corners, and inequalities of thickneſs, ſhould, as much as poſſible, be avoided. The globular form is the beſt of all, and next to it are thoſe forms which approach neareſt to it; and the thinner the utenſil is made, conſiſtent with the requiſite ſtrength to reſiſt occaſional blows, the better it will be in all reſpects.

The beſt compoſition for earthen ware for culinary purpoſes is, I am told, pounded Heſſian cruſibles, or any kind of broken earthen ware of that kind, reduced to powder, and mixed with a very ſmall proportion of Stourbridge clay.

The method of glazing this ware with ſalt is by throwing decripitated common ſalt into the top of the kiln, with an iron ladle, through ſix or eight holes made for that purpoſe in different parts of the top of the kiln. Theſe holes, which need not be more than four inches in diameter, each, may be kept covered with common bricks laid over them.

The ſalt ſhould not be thrown in till the ware is ſufficiently burnt, and till it has acquired the moſt intenſe heat that can be given it; and the holes ſhould be immediately cloſed as ſoon as the ſalt is thrown in. If as much as a large handful of ſalt be thrown into each hole, that will be ſufficient, unleſs the kiln be very large.

The ſalt is immediately reduced to vapour by the intenſe heat, and this vapour expands itſelf, and fills every part of the kiln, and diſpoſes the ware to vitrify at its ſurface.

I have made ſeveral attempts to protect ſtew-pans and ſauce-pans of earthen ware from danger from ſudden heat, and from accidental blows, by covering them on the outſide with ſheet-copper, and with ſheet-iron, and in theſe attempts I have ſucceeded tolerably well. Several ſtew-pans covered in this manner may be ſeen in the kitchen, and in the repoſitory of the Royal Inſtitution. As the ſubject is of infinite importance to the health and comfort of mankind, I wiſh that ſome ingenious and enterprizing tradeſman would turn his attention to it.

As cooking utenſils of tinned iron are incomparably leſs dangerous to health than thoſe which are made of copper, I have taken conſiderable pains to get ſerviceable ſtew-pans and ſauce-pans made of that material. The great difficulty was to unite durability with cheapneſs and cleanlineſs. How far I have ſucceeded in this attempt will be ſeen hereafter.

As it is probable the copper ſtew-pans and ſauce-pans will continue to be uſed, at leaſt for a conſiderable time to come, notwithſtanding the objections which have ſo often been made to that poiſonous metal; I ſhall proceed to an inveſtigation of the beſt *forms* for thoſe utenſils.

Before I proceed to a conſideration of the improvements that may be made in the forms of kitchen utenſils, I muſt beſpeak the patience of the reader. It is quite impoſſible to make the ſubject intereſting to thoſe who read merely for amuſement; and ſuch would do well to paſs over the remainder of this chapter without giving it a peruſal; but I dare not treat any part of a ſubject lightly, which I have promiſed to inveſtigate. Beſides this, I really think the details, in which I am now about to engage, of no inconſiderable degree of importance; and many other perſons will, no doubt, be of the ſame opinion reſpecting them. The ſmalleſt real improvement of any utenſil in general and daily uſe, muſt be productive of advantages that are incalculable. It is probable that more than a million of kitchen-boilers and ſtew-pans are in uſe every day, in the United Kingdom of Great Britain and Ireland; and the providing and keeping kitchen furniture in repair is a heavy article of expence in houſekeeping. I am certain that this expence may be conſiderably leſſened; and in doing this, that kitchen utenſils may be made much more convenient, neat, and elegant, than they now are.

As it is indiſpenſably neceſſary, in recommending new mechanical improvements, not only to point out what alterations ought to be made, but alſo to ſhow diſtinctly *how the work to be done, can be executed in the eaſieſt, and beſt manner*; the fear of being by ſome thought prolix and tireſome, muſt not deter me from being very particular and minute in my deſcriptions and inſtructions.

In juſtice it ought always to be remembered, that my object in writing is, profeſſedly to be uſeful; and that I lay no claim to the applauſe of thoſe delicate and ſevere judges of literary compoſition, who read more with a view to being pleaſed by fine writing, than to acquire information. If thoſe who are quick of apprehenſion are ſometimes tempted to find fault with me for being too particular, they muſt remember, that it is not given to all to be quick of apprehenſion;—and that it is amiable to have patience, and to be indulgent.—But to proceed.

As the fire employed in heating ſtew-pans, ſaucepans, &c. may be applied in a variety of different ways; and as the form of the utenſil ought in all caſes to be adapted to the form of the fire-place, and to the mode of applying the heat, it is neceſſary, in laying down rules for the conſtruction of ſtew-pans and kitchen boilers, to take into conſideration the conſtruction of the fire-places, in which they are to be uſed. But kitchen fire-places, conſtructed on the beſt principles, are ſuſceptible of a variety of different forms,

In the ſpacious dwellings of the rich, where large rooms are ſet apart for the ſole purpoſe of cooking, a number of ſeparate fire-places, in large maſſes of brick-work, conſtructed on the principles adopted in the kitchen of Baron de Lerchenfeld, at Munich, will be found moſt convenient; (ſee page 39, Part I. of this Eſſay*); but for perſons of moderate fortunes, to whom the economy of houſe-room is an object of importance, a leſs expenſive arrangement may be choſen.

It is very eaſy (as will be ſhewn hereafter) ſo to arrange the implements neceſſary in cooking for a moderate family, as to leave the kitchen, not merely an habitable, but alſo a perfectly comfortable, and even an elegant room. All thoſe who have ſeen the kitchen in my houſe, at Brompton,

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* For all ſuch fire-places, at leaſt for all ſuch as are deſtined for heating ſtew-pans and ſauce-pans, I am quite ſure that *wood* is the cheapeſt fuel that can be uſed, even here in London, where it bears ſo high a price. It is certainly the moſt cleanly, and moſt convenient, and makes the moſt manageable fire. I found by an experiment, made on purpoſe to aſcertain the fact, that any given quantity of wood, burnt in a cloſed fire-place, gives very near *three times* as much heat as it would give if it were firſt reduced to charcoal, and then burnt in the ſame fire-place. But the great advantage of uſing wood as fuel in the ſmall fire-places of ſtew-pans and ſauce-pans, is, the facility with which it may be kindled, and the facility and quickneſs with which the fire may be put out (by ſhutting the dampers) when it is no longer wanted.

ton, (which was fitted up principally with a view to exemplify that important fact) will not doubt the truth of this aſſertion.

In treating the ſubject I have propoſed to inveſtigate in this chapter, I ſhall firſt conſider what forms will be beſt for ſauce-pans and ſtew-pans that are deſigned to be uſed in fixed fire-places; and ſhall then ſhew how thoſe ſhould be conſtructed, which are deſigned to be heated in a different manner.

Of the Conſtruction of Sauce-pans and Stew-pans for fixed Fire-places.

The reaſons have already been given why ſtew-pans and ſauce-pans ought always to be circular. They are indeed always made in that form; but ſtill, as they are commonly conſtructed, they have a fault which renders them but ill adapted for the cloſed fire-places I have recommended. Their handles being faſtened to them on their outſides (by rivets) the regularity of their form is deſtroyed, and they cannot be made to fit well to the circular openings in their fire-places, which they ought to occupy, and to fill.

There are two ways in which this imperfection may be remedied; the firſt, which is the leaſt expenſive, but which is alſo at the ſame time the leaſt perfect, is to rivet the handle to the *inſide* of the ſauce-pan. This leaves the *outſide* of the ſauce-pan circular, or cylindrical, that is to ſay, if care is taken to beat down the heads of the rivetting nails, and to make them flat and even with the outſide ſurface of the veſſel; but the regularity of the form of the inſide of the ſauce-pan will in this caſe be ſpoiled by that part of the handle that enters the ſauce-pan; which circumſtance will not only render it more difficult to keep the ſauce-pan clean; but will alſo make it impoſſible to cloſe it well with a circular cover. The cover may indeed be ſo contrived as to fit the opening of the ſauce-pan, by making a notch in one ſide of it to receive that part of the handle which is in the way; and in this manner I have ſometimes cauſed kitchen utenſils already on hand to be altered and made to ſerve very well for cloſed fire-places. The Figures 23 and 24 will give a perfect idea of the manner in which theſe alterations were executed.

Fig. 23.

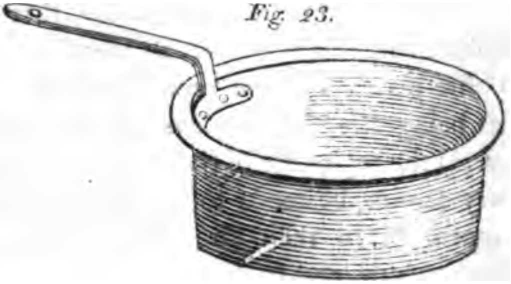
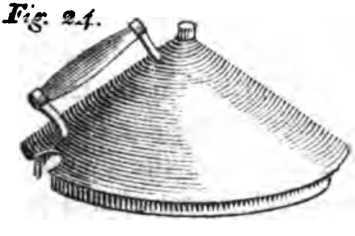


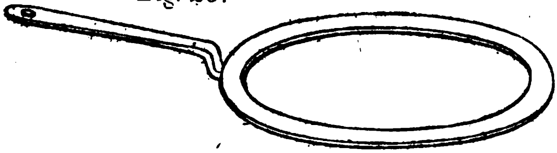
Fig. 24.



But, when new ſauce-pans and ſtew-pans are conſtructed, I would ſtrongly recommend the following more ſimple and more advantageous contrivance:

A circular rim of iron ſhould be provided for each ſauce-pan, with a handle belonging to it, of the form here repreſented;

Fig. 25.



and by forming the ſauce-pan to this rim, its form at its brim will be circular *within* and *without*; and conſequently the ſauce-pan will exactly fit the circular opening of its fire-place, and will at the ſame time be exactly fitted by its *circular cover*. No attention will in that caſe be neceſſary, in putting on the cover, to place it in any particular manner or ſituation,—and the ſauce-pan, not being pierced with holes for rivets, will, on that account, be leſs liable to leak, and will alſo be more durable, and more eaſily kept clean*.

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* One reaſon is obvious why ſtew-pans without rivets ſhould be more durable than thoſe which have their handles rivetted to them; but there is another reaſon more occult, which requires the knowledge of a late diſcovery in chemiſtry, to underſtand. When iron and copper, in contact with each other, are placed in a ſituation in which they are expoſed to be frequently wetted, they act on each other, very powerfully, and one of the metals

The circular iron rim above recommended ſhould be broad and flat; from $\frac{2}{10}$ to $\frac{3}{10}$ of an inch in thickneſs, and from $\frac{1}{2}$ an inch to $\frac{3}{4}$ of an inch in width. Its handle, which muſt be welded faſt to it, and muſt project from one ſide of it, may be from $1\frac{1}{4}$ inch to $1\frac{1}{2}$ in width, from 6 to 8 or 10 inches long, and of the ſame thickneſs as the circular rim, where it joins it.

The under ſide of this flat iron rim ſhould be made perfectly flat, in order that the ſauce-pan,

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metals will ſoon be deſtroyed by ruſt. When ſhips firſt began to be covered with copper this fact was not known, and great inconvenience was found to ariſe from the rapid decay of the iron bolts in the veſſels ſo covered. As there appeared to be no remedy for this evil, it was found neceſſary to ſubſtitute copper bolts for iron bolts, in conſtructing ſhips intended to be coppered. Theſe effects are now known to depend on what (from the name of its diſcoverer) has been called the *Galvanic influence.*

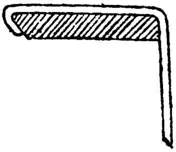
It appears to me to be highly probable that ſtew-pans and ſauce-pans, conſtructed in the manner above deſcribed, would laſt more than twice as long as thoſe made in the uſual manner. Frequent attempts have been made to line copper boilers and ſauce-pans with tinned iron (commonly called ſheet-tin) in order to guard againſt the poiſonous qualities of the copper; but none of theſe have ſucceeded ſo well as was expected; the tin being found to be deſtroyed by ruſt with uncommon rapidity. This, no doubt, was owing to the influence of the ſame cauſe by which the iron bolts of coppered ſhips were ſo ſuddenly deſtroyed.

If handles muſt be riveted to the ſides of copper ſauce-pans or boilers, ſuch handles ſhould be made of copper, and not of iron; and the nails by which they are faſtened, ſhould likewiſe be copper. They would coſt ſomething more, at firſt, but the utenſils would laſt ſo much longer, that they would turn out to be much the cheapeſt in the end.

by being ſuſpended by it in its fire-place, may ſo completely cloſe the circular opening of the fire-place, as to prevent the ſmoke from coming into the room; and alſo to prevent (what would be much more likely to happen)—the cold air of the room from deſcending into the fire-place, and mixing *there* with the flame and ſmoke, and afterwards going off, thus heated, through the chimney, into the atmoſphere.

The copper ſauce-pan or ſtew-pan is to be faſtened to its iron rim by being turned over its outward edge; and in order that the copper, thus turned over the outward edge of the iron rim, may hold faſt without projecting below the level of the lower flat ſurface of the ring (which would be attended with inconvenience), the lower part of the outward edge of the ring muſt be chamfered away, in the manner repreſented in the following figure (26), which ſhews a vertical ſection of the ring, of the full ſize, with the copper turned over it.

Fig. 26.

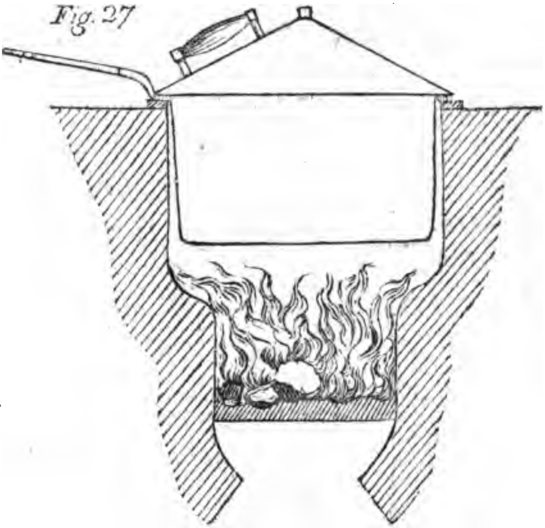


The upper inſide edge of this iron ring may be rounded off, as it is repreſented to be in the above figure. In this figure the ſection of the ring is diſtinguiſhed by diagonal lines; and that of the copper, (which is turned over it), by two parallel crooked lines.

When ſtew-pans and ſauce-pans are conſtructed on the principles here recommended (with flat circular iron rings), an advantage will be attained, which in many caſes will be found to be of no ſmall importance: they will be well adapted for being uſed in ſmall portable fire-places, heated by charcoal; or in portable ſtoves, heated (or rather kept hot) by heaters. Deſcriptions of theſe portable fire-places and heater-ſtoves will be given in the ſequel of this work.

As the upper part of the circular opening of the fire-place (Fig. 27.) on the top of which the lower part of the circular rim of the ſauce-pan repoſes, is nearly on a level with the top of the ſolid maſs of the brick-work, it is neceſſary that the handle of the ſauce-pan ſhould be bended upwards, ſo as to be above the level of the brim of the ſauce-pan; otherwiſe, when the ſauce-pan is in its place, there would not be room between the handle and the ſurface of the brick-work for the fingers to paſs in taking hold of the handle to remove the ſauce-pan. This is evident from a bare inſpection of the following figure (27); which repreſents the ſection of a ſauce-pan conſtructed on the plan here propoſed, fitted into its fire-place.

Fig. 27



There ſhould be a round hole, about a ¼ of an inch in diameter, near the end of the handle, by which the ſauce-pan may occaſionally be hung up on a nail, or peg, when it is not in uſe. The cover belonging to the ſauce-pan may be hung up on the ſame nail, or peg, by means of the projection of its rim.

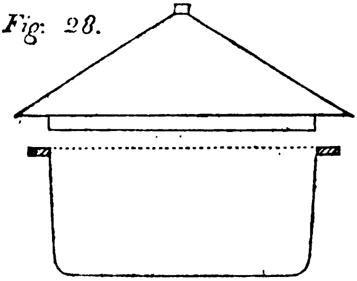
Theſe will be thought trifling matters; but it muſt not be forgotten that convenience, and the economy of time, are often the reſult of attention to the arrangement of things apparently of little importance.

In conſtructing *the cover of a ſauce-pan*, care muſt be taken to avoid a fault, into which it is eaſy to fall, and which, as I have found by experience, will be attended with diſagreeable conſequences.

ſequences. The circular plate of tin, or of thin ſheet-copper tinned, which forms the bottom of the cover, ſhould be of the ſame diameter *preciſely* as the outſide of the brim of the ſauce-pan.

I once thought it would be better to make the bottom of the cover rather *larger* than the top of the brim of the ſauce-pan, as it is repreſented in the following ſection.

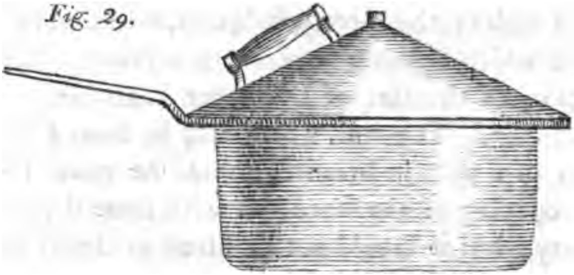
Fig: 28.



I imagined that it would prevent any thing that happened by accident to be ſpilled on the cover, from finding its way into the ſauce-pan, and ſpoiling the victuals; and this indeed it would do moſt effectually; but it often occaſioned another accident not leſs diſagreeable in its effects; it drew the ſmoke into the ſauce-pan, which happened to eſcape by the ſides of the circular opening of the fire-place.

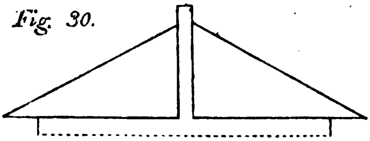
When the cover is preciſely of the ſame diameter as the brim of the ſauce-pan, there is little danger of any thing entering the ſauce-pan in this manner, as will be evident from an inſpection of the following figure.

Fig. 29.



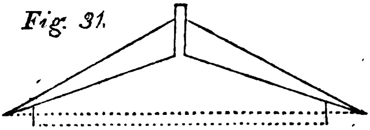
The bottom of the cover may either be made quite flat, as in this ſection:

Fig. 30.



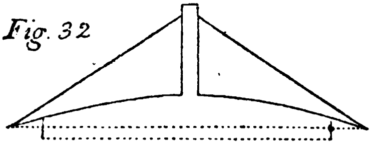
Or it may be made concave, and of a conical form, thus:

Fig. 31.



Or concave, and of a ſpherical figure, as is repreſented in the following figure:

Fig. 32.



The only utility derived from making the bottom of the cover hollow, inſtead of flat, is, that a little more room is left for the boiling up, or ſwelling of the contents of the ſauce-pan. Cooks will be beſt able to judge how far this is an object of importance.

In each of the three laſt figures, a ſection of the tube which carries off the ſteam is ſhewn, as alſo a ſection of the rim of the cover that enters the ſauce-pan. This rim, which may be from ¾ of an inch to 1 inch in breadth, ſhould be made to fit the opening of the ſauce-pan with ſome degree of nicety; but it ſhould not be fitted ſo cloſely as to require any effort in removing it, or ſo as to render it neceſſary to uſe both hands in doing it—one to hold the ſauce-pan faſt in its place, and the other to take off its cover.

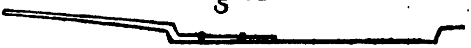
The ſteam tube of the cover, which may be ½ an inch or ⅓ of an inch in diameter, and ſhould project about ½ an inch above the top of the cover, muſt paſs through both the top and the bottom of the cover, and muſt be well fitted and ſoldered in both, in order that the air between the top of the cover and its bottom may be confined and completely cut off from all communication with the ſteam, and alſo with the external air. This ſteam tube ſhould have a fit ſtopple, which may be made of wood, and which, to prevent its being loſt, ſhould be attached to the top of the cover, by a ſmall wire chain, about 2 or 3 inches long.

In reſpect to the handles of theſe covers, the choice of the form to be adopted may be left to the workman who is employed to make the cover; for, excepting in certain caſes, which will be particularly noticed hereafter, it is a point of little importance.

It is right that I ſhould obſerve here, that though the covers I have here deſcribed are ſuch as I have generally recommended, yet others of different forms may be conſtructed on the ſame principles that very poſſibly may anſwer quite as well as theſe, and coſt leſs. The ſteam tube, for inſtance, for ſmall ſauce-pans, may with ſafety be omitted, and the ſteam be left to make its way between the rim of the cover and the ſauce-pan; and ſhould it be thought an improvement, the upper part of the cover, inſtead of being a cone, may be a ſegment of a ſphere.

The following figure is the ſection of the cover of a ſauce-pan, now in general uſe in this country.

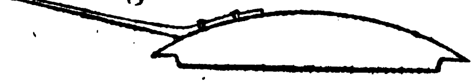
Fig: 33



It is made of a circular piece of ſheet copper, and its handle, which is of iron, is faſtened to it by rivets; and it is tinned on the under ſide. Its form is ſuch that it fits without a rim into the ſauce-pan to which it belongs.

This cover might be greatly improved, and perhaps rendered as well adapted for confining heat as any metal cover whatever, merely by covering it above with a thin circular plate of tinned iron, or of copper, either quite flat, or convex, like that repreſented by this figure.

Fig. 34.



It can hardly be neceſſary for me to obſerve, that this thin circular plate muſt be well ſoldered to the cover, all round its circumference, in order to confine the air that is intercepted between the upper ſurface of the cover and the lower ſurface of this plate.

For the mere purpoſe of confining the heat in a ſtew-pan or ſmall boiler—were ſuperior neatneſs and cleanlineſs not objects of particular attention—one of the very beſt covers that could be uſed would be a common ſauce-pan cover, defended above from the cold air of the atmoſphere by a circular cover of wood, firmly fixed to it by means of a ſcrew, or a rivet.

Fig. 35.

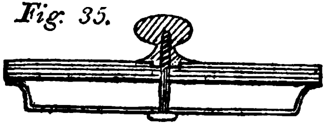


Fig. 36.

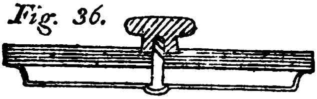
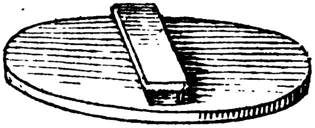


Fig. 37.



The following Figures repreſent covers ſo defended; and were the circular piece of wood, to prevent its warping, to be compoſed of two or three very thin boards, glued faſt to each other, and nailed or rivetted together, to unite them more ſtrongly, I am inclined to think that this would be one of the beſt covers for common uſe, eſpecially for large ſtew-pans, that could be made. Its handle might be made of wood, and of either of the forms repreſented in theſe figures, or of any other ſimple form.

The covers for large ſtew-pans ſhould always be furniſhed with ſteam tubes, in order that the ſteam, when it becomes too ſtrong to be confined, may eſcape without deranging or lifting up the cover.

A cover made entirely of wood might anſwer very well for confining heat, eſpecially if care were taken to conſtruct it in ſuch a manner as to prevent its being liable to be warped by the heat, and by the moiſture, to which it is continually expoſed; but the wooden covers of boilers, ſauce-pans, and ſtew-pans, require much attention to keep them clean, unleſs they be lined with tin, or with ſheet-copper.

Having now finiſhed my obſervations on the covers of ſmall boilers and ſauce-pans, *in their moſt ſimple ſtate*; when they are deſigned merely for confining heat; it remains to conſider of the means that may be put in practice to render them uſeful in *directing* the heat that eſcapes in the ſteam, which is formed when liquids are boiled, in the various proceſſes of cookery, and *employing this heat to uſeful purpoſes.*

As the quantity of heat that exiſts in ſteam is very conſiderable (as has been elſewhere obſerved) the recovery of this heat is frequently an object deſerving of attention; but before we proceed in this enquiry, it will be neceſſary to ſay ſomething reſpecting the method of *Cooking in Steam.* This ſubject will be treated in the following chapter.

CHAPTER VIII.

Of Cooking in Steam—Objections to the ſteam-kitchens now in uſe—Principles on which a ſteam apparatus for cooking ſhould be conſtructed—Deſcriptions of fixed boilers for cooking with ſteam—A particular deſcription of a STEAM-RIM *for boilers, by means of which their covers may be made ſteam-tight—Deſcription of a* STEAM-DISH, *to be uſed occaſionally for cooking with ſteam over a kitchen boiler—Account of what has been called a* FAMILY-BOILER; *many of them have already been ſold, and have been found very uſeful—Hints to Cooks, concerning the means that may be uſed for improving ſome popular diſhes.*

AS the art of cooking with ſteam is well known, and has long been ſucceſsfully practiſed in this country, it would be a waſte of time to attempt to prove, what is univerſally acknowledged, namely, that almoſt every kind of food uſually prepared for the table in boiling water, may be as well cooked, and in many caſes better, by means of boiling-hot ſteam. I ſhall therefore confine my preſent enquiries to the inveſtigation of the beſt methods of confining and directing ſteam, and employing it uſefully with the moſt ſimple and leaſt expenſive apparatus.

Steam-kitchens, as they are called, conſiſt of very expenſive machinery, and I have been informed

formed by ſeveral perſons who have uſed them, that they do not produce any conſiderable ſaving of fuel. Bare inſpection is indeed ſufficient to ſhew that they cannot be economical in that reſpect; for the ſurface of the tin ſteam-veſſel filled with hot ſteam, that is expoſed quite naked to the cold air of the atmoſphere, is ſo great, that it muſt neceſſarily occaſion a very conſiderable loſs of heat.

A primary object in contriving a ſteam apparatus for cooking, ſhould be to prevent the loſs of heat *through the ſides of the containing veſſels*; and this is to be done, firſt, by expoſing as ſmall a ſurface as poſſible to the atmoſphere; and ſecondly, by covering up that ſurface with the warmeſt covering that can conveniently be uſed, to defend it from the cold air.

The ſteam-veſſel in the kitchen of the Foundling Hoſpital, is a large wooden box, lined with tin, capable of containing a large quantity of potatoes; and the ſteam comes through a ſmall tin tube, from an oblong quadrangular iron boiler, which is uſed daily for boiling meat, &c. for the Hoſpital. As this boiler is furniſhed with what I have called a *ſteam-rim* (which will preſently be deſcribed) when the (wooden) cover of the boiler is down, all the ſteam that is generated in the boiler is forced to paſs through the ſteam-box, and the potatoes, greens, &c. that are in the box are cooked, without any additional expence of fuel.

The ſteam-box has a ſteam-rim, and alſo a wooden cover, which, when it is down, cloſes the box, and makes it perfectly ſteam-tight.

When ſteam is generated faſter than it can be condenſed in the ſteam-box, that which is redundant paſſes off by a waſte tube, which conducts it into a neighbouring chimney.

The apparatus for cooking with ſteam in the kitchen of the Houſe of Correction, at Munich, is ſtill more ſimple. Here, two equal quadrangular boilers are ſet, one at the end of the other, at the ſame level, in the ſame maſs of brick-work, and the flame and ſmoke from the ſame fire paſs under them both; (ſee Eſſay X. Part I. plate iv. fig. 7, and plate v. fig. 9.) Both boilers being incloſed in brick-work, and being covered with wooden covers, it is evident that no part of the apparatus is expoſed to the cold air.—I ſay *no part* of it; for the covers of the boilers being of wood, which is one of the worſt conductors of heat, very little heat can make its way through them; and to prevent even this loſs, inconſiderable as it is, theſe wooden covers may, if it ſhould be thought neceſſary, be defended from the cold air, by warm rugs thrown over them.

The ſmoke which paſſes under the ſecond boiler, not only prevents the approach of the cold air to the under ſurface of its bottom, but, acting on the ſmall quantity of water that is contained in it, actually aſſiſts in the generation of ſteam. It even happens ſometimes, (namely, when there is but a ſmall quantity of water in the ſecond boiler, and the firſt is nearly filled with cold water) that the water in the ſecond boiler actually boils, and fills the boiler with ſteam, before the water in the firſt boiler is heated boiling hot.

This appears to me to be one of the moſt economical methods that can be uſed for cooking, and that it is well adapted for hoſpitals, and alſo for large private families. If it ſhould be neceſſary to make proviſion for cooking a great number of different diſhes in ſteam at the ſame time, either the ſteam-boiler may be made ſufficiently large to receive them; or, inſtead of it, two or more ſteam-boilers, of a moderate ſize, may be put up; and if the different kinds of food that are cooked at the ſame time in the ſame ſteam-boiler, be placed each in a ſeparate diſh, and covered over with ſome proper veſſel in the form of a bell (a common earthen pot, for inſtance, turned upſide down) the exhalations from the different kinds of food will be prevented from ſo mixing together as to give an improper taſte or flavour to any of the victuals.

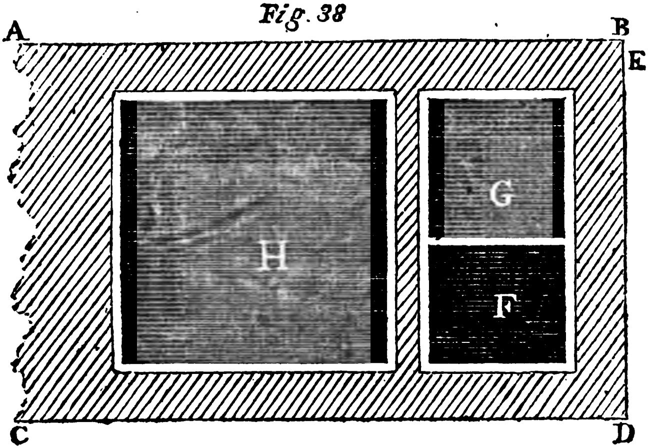
Theſe covers to the different diſhes will likewiſe be uſeful on another account; when the cover of the ſteam-boiler is opened, for the purpoſe of examining, or of introducing or removing any diſh, the proceſs of cooking going on in the other diſhes will not be interrupted: for their bell-like covers remaining filled with ſteam, will prevent the cold air from coming into contact with the victuals. It is true, that the cover, or lid, of the ſteam-boiler muſt not be kept open too long, otherwiſe the ſteam confined under the covers of the diſhes will be condenſed, and the cold air will find its way under them.

In order that theſe boilers may be perfectly ſteam-tight when their lids are down, they muſt all be furniſhed with *ſteam-rims*; and there muſt be a tube of communication between them for the paſſage of the ſteam; and another tube to carry off the redundant ſteam from the boiler which is ſituated fartheſt from the fire.

If it ſhould be neceſſary, the principal boiler may, without any difficulty or inconvenience, be divided into two compartments, ſo as to render it poſſible to prepare two different kinds of ſoup, or to boil two different things ſeparately, at the ſame time. Suppoſe, for inſtance, that the apparatus is deſigned for the kitchen of a large family, and that the principal boiler is 12 inches wide, 24 inches long, and 12 inches deep; this may be ſo divided by a vertical partition, as to form two compartments; the one—that immediately over the fire, for inſtance, 12 inches by 10; and the other 12 inches by 14. In this caſe I ſhould make the ſecond, or *ſteam-boiler*, 24 inches ſquare by 12 inches deep, and ſhould cauſe the ſmoke to circulate in three flues, parallel to each other; the firſt (in the hither end of which the fire-place ſhould be ſituated) ſhould be immediately under the firſt boiler; and the ſecond and third ſhould be under the ſecond boiler.

The following figure ſhews the manner in which theſe boilers ſhould be ſet :

Fig. 38



A, B, is the ſide of the room. A, C, D, E, the maſs of brick-work in which the boilers are ſet.

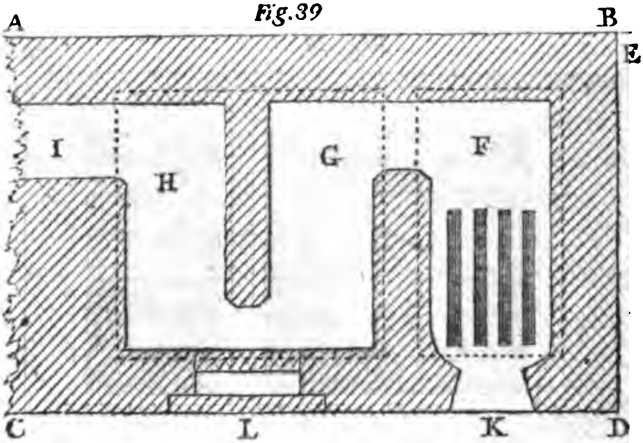
F, and G, are the two compaartments of the firſt boiler, wh;ch is ſhewn with its ſteam-rim.

H. is the larger boiler, which is alſo repreſented with its ſteam-rim.

The covers of theſe boilers (which do not appear in the figure) ſhould be ſo attached to the boilers by hinges, as to be laid back when the boilers are opened, and reſted againſt the ſide ef the room ; and theſe covers ſhould be lined with tin, or with thin ſheet copper, tinned.

The following figure repreſents an horizontal ſection of the brick-work in which theſe boilers are to be ſet, taken at the level of the tops of the flues:

Fig. 39



A, B, is the ſide of the room, and A, C, D, E, the maſs of brick-work, which is placed againſt it. F, G, and H, are the three parallel flues, and I. is the canal that carries off the ſmoke from the ſecond boiler to the chimney. K. is the opening into the fire-place by which the fuel is introduced; and L. is a paſſage, cloſed up with a tile or with looſe bricks, which is occaſionally opened to clean the flues G, and H.

The damper in the canal I, may be placed near the left-hand ſide of the ſecond boiler.

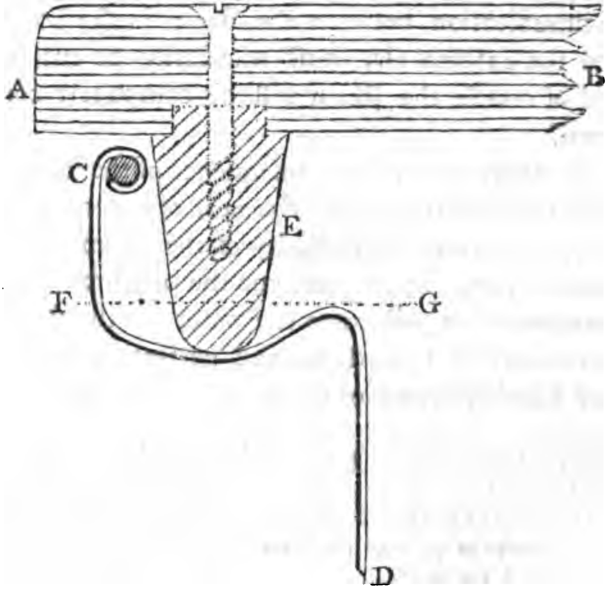
The ſituations of the boilers are indicated by dotted lines.

As it is not neceſſary that I ſhould repeat in this place the directions which have already been ſo amply explained concerning the proper method of proceeding in ſetting boilers, I ſhall not enlarge farther on that ſubject, but ſhall proceed to give an account of a very eſſential part, not yet deſcribed, of the apparatus neceſſary for cooking with ſteam, in the ſimple way I have here recommended: the part I mean is the *ſteam-rim* of the boiler:

Deſcription of a Steam-rim for a Boiler, by means of which its Cover may eaſily be made ſteam-tight.

To give a more complete idea of this contrivance I have, in the following figure, repreſented a vertical ſection of a ſmall part of one ſide of a boiler, and its ſteam-rim, with its (wooden) cover in its place, both of the full ſize:

Fig. 40



A. B. is a ſection of part of the flat wooden cover;

the crooked line C. D. is a ſection of the ſteam-rim, and part of the ſide of a boiler. E. is a ſection of a deſcending rim of wood belonging to, and making an eſſential part of the cover; which rim, when the cover is down, enters the ſteam-rim of the boiler, and repoſes on the bottom of it. In the figure it is repreſented in this ſituation: the wooden rim of the cover is faſtened to the flat part of it by means of wood-ſcrews, one of which is repreſented in the figure *.

Now it is evident, from an inſpection of the figure, that a ſmall quantity of water will lodge in the ſteam-rim, and will ſtand at the level of the dotted line F. G; and as the rim of the cover will enter this water when the cover is ſhut down, all communication between the ſteam in the boiler, and the external air, muſt neceſſarily be cut off, and of courſe the ſteam will be completely confined.

It is true that if, in conſequence of the increaſe of its temperature, above the heat of water boiling in the open air, the elaſticity of the ſteam ſhould become ſufficient to overcome the preſſure of the atmoſphere, it will force the water in the ſteam-rim to aſcend toward C. and getting under the rim E. of the cover of the boiler, it will make its

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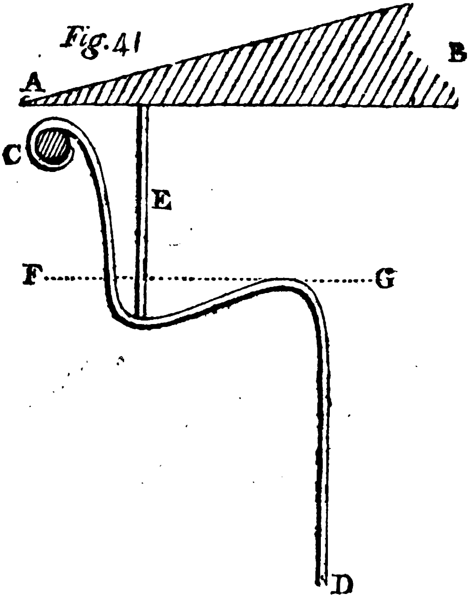
* The cover itſelf is ſuppoſed to be framed and pannelled in the manner deſcribed in the 5th chapter of this Eſſay (part II.) and it ſhould be lined with tin, or with thin ſheet copper, tinned, in order to prevent the wood from being cracked and deſtroyed by the ſteam.

eſcape, but no bad conſequences will reſult from this loſs; on the contrary, the ſteam-rim will, in this caſe, ſerve inſtead of a *ſafety valve*; and although this contrivance may not be adequate to the confining of *ſtrong* ſteam, it certainly anſwers perfectly well for confining that kind of ſteam which is moſt proper to be uſed for cooking. It will likewiſe be found uſeful in many caſes for covering boilers, where the principal object in view is to prevent the contact of the cold air with the contents of the boiler. It will be uſeful for the boilers of bleachers, as alſo for laundry boilers, for brewers boilers, and for all boilers deſtined for the evaporation of liquids under a boiling heat.

It appears to me that this contrivance might, with a little alteration, be uſed with great advantage for covering the boilers uſed by diſtillers. By making the ſteam-rim deeper, the cover of the boiler would be tight, under a conſiderable preſſure; and by making the boiler broad and ſhallow, with ſeveral ſeparate fire-places under it (the flat bottom of the boiler being ſupported on the tops of the flues of theſe fire-places) a variety of important advantages would be gained; and theſe would not be compenſated by any diſadvantages that I can foreſee. The boiler might be conſtructed of very thin ſheet copper, which would not only render it leſs expenſive, but would alſo make it more durable,

When ſteam-rims were firſt introduced, they were made of the form repreſented in the following figure, which repreſents a vertical ſection of part of one ſide of a boiler with a ſteam-rim, covered with a conical double cover, made of tin:

Fig. 41



In this and the following figures, A, B, repreſents a ſection of part of one ſide of the (double) cover of the boiler.

C. D. The ſteam-rim and part of one ſide of the boiler.

E. The deſcending rim of the cover: and,

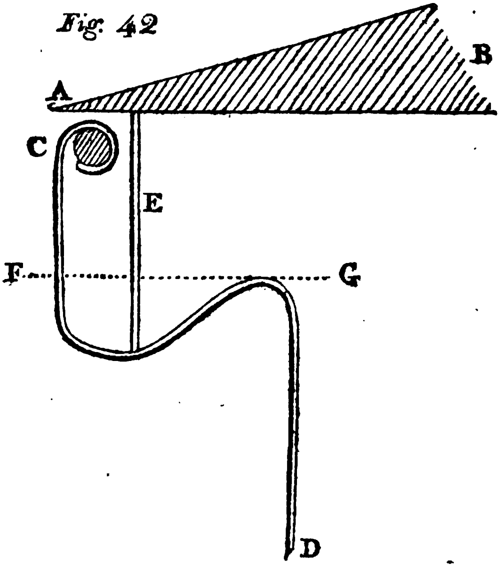
F. G. The level of the water in the ſteam-rim—all of the full ſize.

This conſtruction was found to be attended with an inconvenience, which, indeed, might eaſily have been foreſeen. When the ſteam, on being confined,

fined, became ſtrong enough to force its way under the deſcending rim E. of the cover of the boiler, the water in the ſteam-rim was frequently blown out of it with conſiderable violence, and diſperſed about the room. To prevent theſe diſagreeable accidents, the form of the upper part of the ſteam-rim was altered. To make a proper finiſh to the boiler, the edge of its brim (which forms the top of its ſteam-rim) had been turned *outwards* over a ſtrong wire. It was now turned *inwards* over the wire; and the outſide, or riſing part of the ſteam-rim, inſtead of being made *ſloping outwards*, was now made *vertical*.

A complete idea of theſe different alterations, and of the effects neceſſarily produced by them, may be formed by comparing the foregoing figure (41) with the following:

Fig. 42



It is evident that in this caſe, as there is ſufficient room between the outſide of the deſcending rim of the cover, and the vertical ſide of the ſteam-rim, to contain all the water that can be forced upwards between them by the ſteam, there is little danger of any part of this water being blown out of the ſteam-rim by the ſteam, when it makes its eſcape under the rim of the cover.

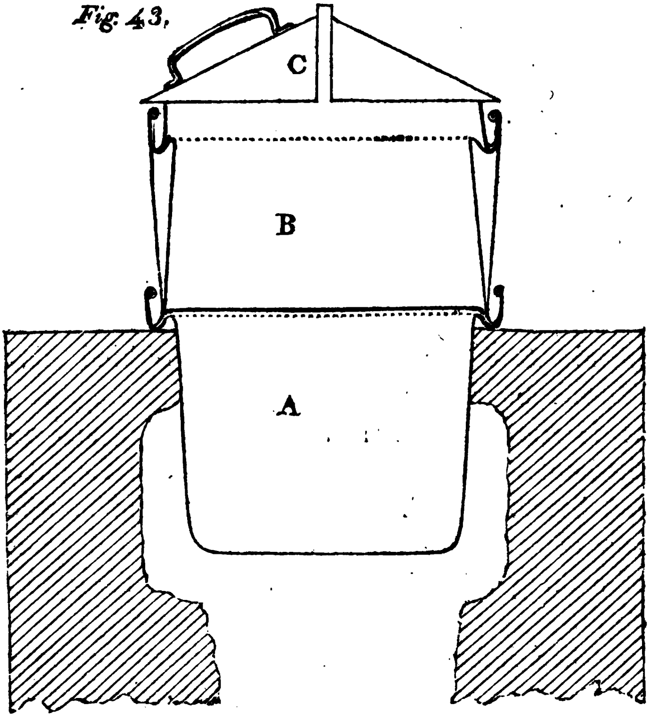
Of the Manner in which Kitchen Boilers and Stew-pans may be conſtructed, ſo as to be rendered uſeful in cooking with Steam.

If a common kitchen boiler be furniſhed with a ſteam rim, and the deſcending rim of its cover be made to ſhut down into it, the ſteam in the boiler will be effectually confined, and may, in various ways, be uſefully employed in cooking. One of the ſimpleſt methods of doing this is to ſet what I ſhall call a *ſteam-diſh* upon the boiler. The bottom of this ſteam-diſh being furniſhed with a deſcending rim, or projection, fitting into the ſteam-rim of the boiler, the ſteam-diſh may be made to ſerve as a cover to the boiler; and if a number of ſmall holes be made in the bottom of this diſh near its circumference, the ſteam will paſs up into it from below; and if it be properly cloſed above, any victuals placed in it will be cooked in ſteam.

If this diſh be furniſhed with a ſteam-rim, of the ſame form and ſize with that of the boiler, the cover of the boiler will then ſerve for covering the ſteam-diſh, whenever that diſh is in uſe.

The following figure, which repreſents a vertical ſection of the apparatus, will ſhow this contrivance in a clear and diſtinct manner:

Fig. 43.



A. is the boiler, which is ſeen ſet in brick-work.

B. is the ſteam-diſh; and

C. is the cover of the boiler, which is here made to ſerve as a cover for the ſteam-diſh.

The ſides of the ſteam-diſh (which is, made of tin) are double, for the purpoſe of confining the heat more effectually.

If

This is a curious circumſtance, and the knowledge of the fact may be turned to a good account. If, for inſtance, it were required to make the ſtrongeſt extract of the pure juices of any kind of meat, unmixed with water; this may be done by heating the meat nearly boiling hot, either in boiling water, or in ſteam, and then putting it, placed in a ſhallow diſh, into a ſteam-diſh, or into any cloſed veſſel filled with hot ſteam, and leaving it in this ſituation two or three hours, or for a longer time: Whatever liquid is found collected in the diſh at the end of the proceſs, muſt neceſſarily be the pureſt juices of the meat. In this manner the richeſt gravies may no doubt be prepared.

Thick ſteaks or cutlets of beef, boiled in this manner, and made perfectly tender throughout, and then broiled on a gridiron, and ſerved up in their own gravy, with or without additions, would, I imagine, be an excellent diſh, and very wholeſome: But it muſt be left to cooks, and to profeſſed judges of good eating to determine, whether theſe hints, (which are thrown out with all becoming humility and deference) are deſerving of attention: For although I have written a whole chapter on the pleaſure of eating, I muſt acknowledge, what

---

taining 11¾oz. or a little leſs than *three quarters of a pint*, this diſh would contain all the water that could poſſibly reſult from the condenſation of ſteam on the ſurface of the meat, in heating it boiling hot.

This computation may be of ſome uſe in determing the dimenſions of the veſſels proper to be uſed for holding the victuals that are cooked in the ſteam-diſhes above deſcribed.

all my acquaintances will certify—that few perſons are leſs attached to the pleaſures of the table, than myſelf. If, in treating the ſubject, I ſometimes appear to do it *con amore*, this warmth of expreſſion ought, in juſtice, to be aſcribed ſolely to the ſenſe I entertain of its infinite importance to the health, happineſs and innocent enjoyments of mankind.

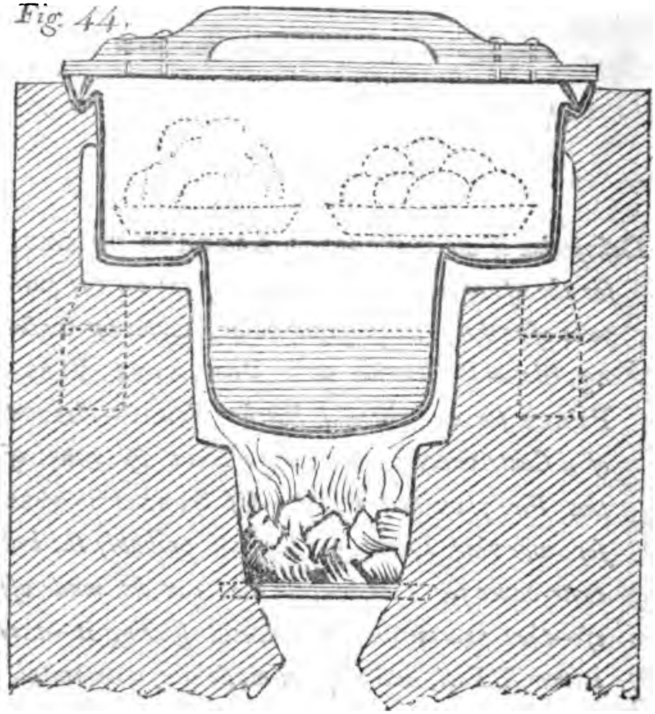
CHAP. IX.

Deſcription of an UNIVERSAL KITCHEN BOILER, *for the uſe of a ſmall family, to anſwer all the purpoſes of cookery; and alſo for boiling water for waſhing, &c.—Deſcription of a* PORTABLE FIRE-PLACE *for an univerſal Kitchen Boiler.—Account of a Contrivance for warming a Room by means of this Fire-place and Boiler.—Of* STEAM STOVES *for warming Rooms.—They are probably the beſt contrivance for that purpoſe that can be made uſe of—they warm the air without ſpoiling it—they economiſe Fuel, and may be made very ornamental.*

Deſcription of an UNIVERSAL KITCHEN BOILER *for the uſe of ſmall Families, to anſwer all the purpoſes of cookery; and alſo for boiling water for waſhing, &c.*

THE following figure repreſents a vertical ſection of this boiler, and alſo of its fire-place and cover.

Fig. 44.



This boiler is ſuppoſed to be made of caſt-iron, and its ſection is repreſented by a double line.

The lower part of it, which is repreſented as being filled about half full with water, is 12 inches in diameter above, about 11 inches in diameter below, and 9 ½ inches deep. The upper part of it, which is furniſhed with a ſteam-rim, is 24 inches in diameter above—where its ſteam-rim begins—and 23 inches in diameter below—where it joins the flat part which unites it to the lower part of the boiler.

The lower part of this boiler (which might, without any impropriety, be called the *lower boiler*) is deſtined for containing the ſoup, or the water that is made to boil, while the upper and broader part is uſed for boiling with ſteam. The brim of the lower boiler projects upward, about an inch above the level of the flat bottom of the upper boiler. This projection prevents the water reſulting from the condenſation of ſteam againſt the ſides of the upper boiler from deſcending into the lower boiler. The upper boiler is 8 ½ inches deep, from the top of the inſide of its ſteam-rim to the flat part of its bottom. The whole depth of both boilers is 18 inches, from the top of the ſteam-rim to the lower boiler.

A circular piece of tin, about 22 inches in diameter, with many holes through it, to give a free paſſage to the ſteam, being laid down, in an horizontal poſition, upon the top, or projecting brim of the lower boiler. Upon this circular plate the ſhallow diſhes are placed, which contain the victuals that are to be cooked in ſteam. Two ſuch diſhes are faintly repreſented in the foregoing figure by dotted lines.

The

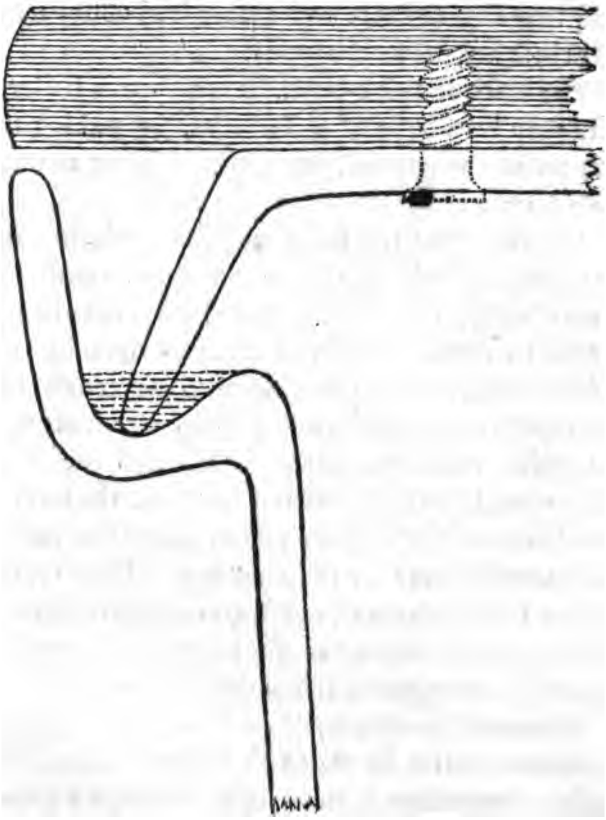
The cover of this univerſal boiler is a ſhallow circular diſh, 26 inches in diameter at its brim, and about 1 ½ inches deep, turned upſide down, and covered above with a circular covering of wood, to confine the heat. The handle to this cover is a ſtrong cleat of wood, faſtened to the circular wooden cover by means of four wood ſcrews. This handle is diſtinctly repreſented in the figure.

The circular wooden cover for confining the heat muſt be conſtructed in pannels, and muſt be faſtened to the ſhallow metallic diſh by means of rivets, or wood ſcrews. In doing this, all the precautions muſt be taken that are pointed out in the 5th chapter of this Eſſay, page 141; otherwiſe the wood and the metal will be ſeparated from each other, in conſequence of the ſhrinking of the wood, on its being expoſed to heat.

The inverted ſhallow diſh, which, properly ſpeaking, conſtitutes the cover of this boiler, may be made either of tin, or of ſheet-iron, or of ſheet-copper; or it may be made of caſt-iron. Whatever the material is of which it is conſtructed, care muſt be taken to make it of ſuch dimenſions preciſely, that its brim may enter the ſteam-rim, and occupy the lower or deepeſt part of it, otherwiſe the ſteam will not be properly confined in the boiler.

The following figure repreſents a vertical ſection, *of the full ſize,* of the ſteam-rim of one of theſe boilers (of caſt iron) together with a ſection of a part of an inverted ſhallow caſt-iron pan, which ſerves as a cover to the boiler, and alſo of the circular covering of wood which is attached to the pan, and defends it from the cold air of the atmoſphere.

Fig. 45



In this figure the ſteam-rim is repreſented as being full of water; and one of the ſcrews is ſeen, which faſten the circular wooden cover to the in-

verted

verted ſhallow pan, which confines the ſteam in the boiler.

On examining the two preceding figures, it will be found that both the boiler and its cover are of forms that will readily deliver from their moulds; and that circumſtance will enable iron-founders to ſell theſe articles at low prices.

The maſs of brick-work, in which this boiler is ſet, may be a cube of 3 feet; or, by ſinking the aſh-pit in the ground, its height may be reduced to 2 ½ feet.

In order that the flame may be made to ſeparate, and ſpread equally on all ſides, under the lower boiler, the ſmoke ſhould be made to paſs off in two ſmall canals, ſituated on oppoſite ſides of the boiler. The openings of theſe canals may be a little below the level of the bottom of what has been called the upper boiler; and the ſmoke being made firſt to deſcend nearly to the level of the bottom of the lower boiler, may then paſs off horizontally towards the chimney. The ſituation of the two horizontal canals (on oppoſite ſides of the boiler) by which the ſmoke goes off, are indicated (in the figure 44.) by dotted lines.

So much has already been ſaid in the foregoing chapters relative to the conſtruction of cloſed fire-places for kitchen boilers, that it would be quite ſuperfluous to give any particular directions reſpecting the conſtruction of the fire-place for this boiler. The manner in which the boiler is ſet in brick-work, and the means that are uſed for cauſing the ſmoke to ſurround it on every ſide, are diſtinctly ſhewn in the figure.

In order more effectually to confine the heat, the boiler ſhould be entirely incloſed in the brick-work on every ſide, in ſuch a manner that the brim of its ſteam-rim ſhould not project above it more than half an inch. To preſerve the brick-work from being wetted, the top of it may be covered with ſheet-lead, which may be made to turn over the top of the brim of the ſteam-rim of the boiler.

There may either be a ſteam-tube in the cover of the boiler, or the ſteam may be permitted to force its way under the deſcending rim of the inverted ſhallow pan, which conſtitutes the cover. If there be a ſteam-tube, it ſhould be half an inch in diameter, and about one inch in length; and it ſhould be made very ſmooth on the inſide, in order that another tube of tin, or of tinned copper, about 10 inches in length, may paſs freely in it. The uſe of this moveable tube is to cauſe the air to be expelled from the upper boiler, while it is uſed for cooking with ſteam. This will be done, if, while the water below is boiling, the long tube be thruſt down into the boiler through the ſteam-tube, till its lower end comes to the level of the brim of the lower boiler. For, as ſteam is conſiderably lighter than common air, it will of courſe riſe up and occupy the upper part of the upper boiler, and the air below it being compreſſed, will eſcape through the tube we have juſt deſcribed; and, although that tube ſhould remain open, the upper boiler will, nevertheleſs, remain filled with ſteam, to the total excluſion of atmoſpheric air. The inſide of the ſteam-tube, and the outſide of the moveable tube ſhould be made to fit each other with accuracy, in order that no ſteam may eſcape between them. The neceſſity of this precaution is too evident to require any illucidation.

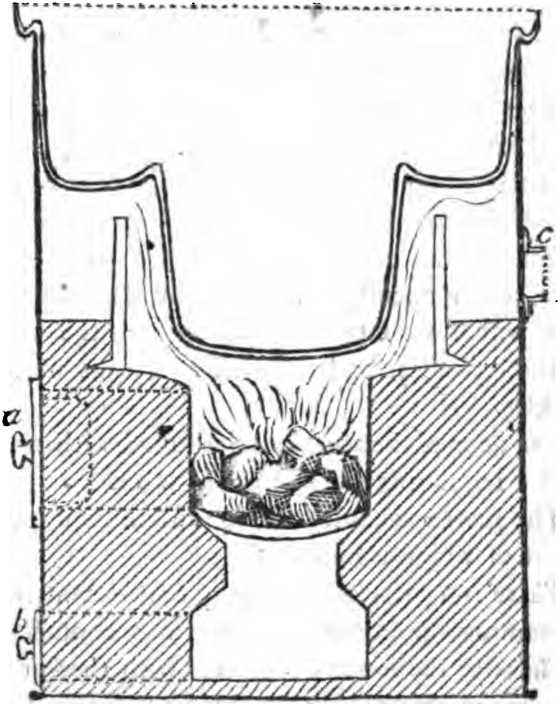
It will be beſt to place the ſteam-tube within about an inch of the ſide of the cover, in which caſe it will be eaſy, by turning the cover about, to place it in ſuch a poſition that the moveable tube may deſcend into the upper boiler, without being ſtopped by meeting with any of the diſhes that are placed in it.

It is hardly neceſſary that I ſhould obſerve here, that boilers on the principles above deſcribed may be conſtructed of ſheet-iron, or ſheet-copper, as well as of caſt-iron, and that they may be made of any dimenſions. That which is repreſented in the foregoing figure (44.) is of a moderate ſize, and would, I ſhould imagine, be ſuitable for the family of a labourer, conſiſting of eight or ten perſons. The lower part of the boiler would hold about 3 3/10 gallons; but the whole boiler, filled up to within an inch of the level of the inſide of the ſteam-rim, would hold 14¼ gallons. When ſo filled up, I ſhould ſuppoſe the boiler to be ſufficiently capacious to heat water for waſhing, or for any other purpoſe that could be wanted by an induſtrious family, conſiſting of the number of perſons above-mentioned.

Deſcription of a PORTABLE FIRE-PLACE *for an* UNIVERSAL KITCHEN BOILER.

The following figure repreſents a vertical ſection of the fire-place, with its boiler in its place.

Fig. 46.



This figure is drawn to a ſcale of 10 inches to the inch.

The boiler is ſuppoſed to be of caſt-iron, and the ſection of it is repreſented by a double line. To render its form more conſpicuous, its cover is omitted.

The portable fire-place is a cylinder of ſheet-iron, 24¼ inches in diameter, and 34¼ in height, open above, and cloſed below. The ſections of this cylinder, and of its bottom, are marked by ſtrong black lines.

The fire-place, properly ſo called, is the center, or axis of this cylinder: it is built of fire-bricks and ſturbridge clay; and the fire burns on a circular caſt-iron diſhing grate, eight inches in diameter.

The opening (at *a.*) by which the fuel is introduced, is marked by dotted lines; as is alſo another opening below it (at *b.*) which leads to the aſh-pit. Theſe openings are cloſed by doors of ſheet-iron, which are attached by hinges to the outſide of the cylinder, and faſtened by means of turn-buckles.

The door of the aſh-pit is furniſhed with a regiſter for regulating the admiſſion of air.

The ſmoke is carried off by an horizontal tube, a part of which is ſeen at C.

There is a particular and very ſimple contrivance for cauſing the ſmoke to come into contact with the ſides of the lower boiler, and with the flat bottom of the upper boiler, and then to *deſcend* before it is permitted to paſs off. This is a cylinder of caſt-iron or of earthen-ware, which is 16 inches in diameter within, or in the clear, and 8 inches high, with a thin flanch about an inch wide, at its lower extremity. This flanch ſerves as a foot for keeping it ſteady in its vertical poſition, and alſo for faſtening it in its place, by laying the ends of a circular row of ſhort pieces of brick upon it. The lower end of this cylinder being ſet down at the level of the bottom of the lower boiler, upon the top of the hollow cylindrical maſs of brick-work which conſtitutes the fire-place, the ſmoke is obliged to paſs up between the inſide of this cylinder and the outſide of the lower boiler, and to ſtrike againſt the flat bottom of the upper boiler. It then paſſes horizontally over the top of this cylinder, and turning downwards into the ſpace which is left for it, between the outſide of this ſhort cylinder and the great cylinder of ſheet-iron in which the boiler is ſuſpended, it paſſes off by the ſmall horizontal tube which carries it to the chimney.

This ſhort cylinder is ſo diſtinctly repreſented in the figure, that letters of reference are quite unneceſſary.

A piece of brick, or of fire-ſtone, about 2 ½ inches thick, is ſuppoſed to be attached to the inſide of the fire-place door, to prevent its being too much heated by the fire; and this is repreſented in the figure by dotted lines. The knobs in the fire-place door, and in the door of the aſh-pit, are deſigned to be uſed as an handle in opening them.

This portable fire-place may have two ſtrong handles for tranſporting it from place to place; and as the boiler may be removed, and carried ſeparately, the fire-place will not be too heavy to be carried very conveniently by two men.

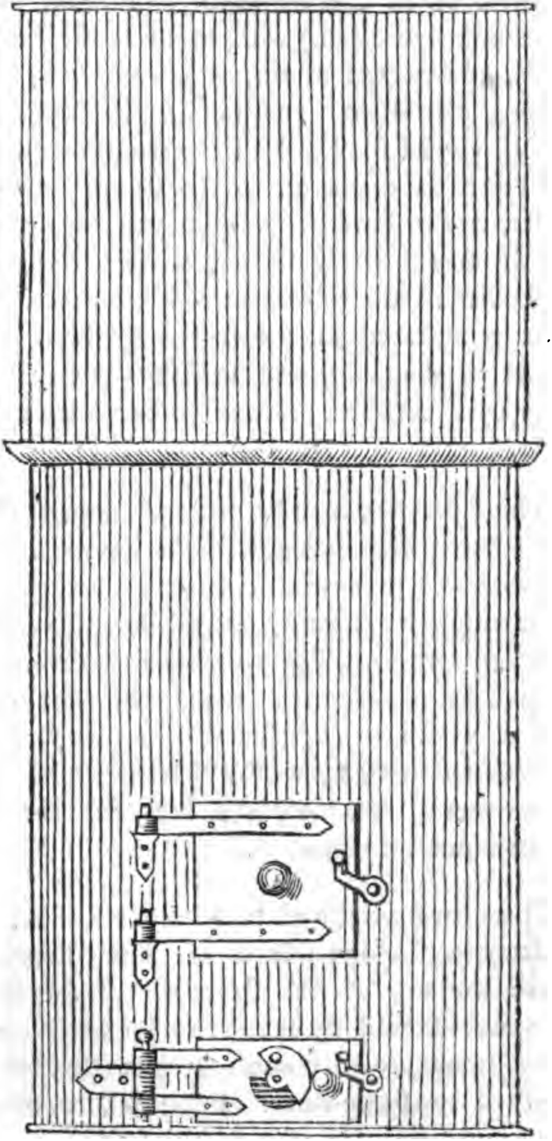
Without ſtopping to expatiate on the uſefulneſs of this new implement of cookery, I ſhall proceed to ſhew how its utility may be made ſtill more extenſive. With a trifling additional expence, it may be changed into one of the very beſt ſtoves for warming a room in cold weather that can be contrived.—I ſay one of the *very beſt*, for it will warm the air of the room, without its being poſſible for it ever to heat it ſo much as to make it unwholeſome; and it will do it with the leaſt trouble, and at the expence of the leaſt poſſible quantity of fuel.

Deſcription of a contrivance for warming a room, by means of a PORTABLE UNIVERSAL KITCHEN BOILER.

The following figure repreſents an elevation, or front view of the machinery that may be uſed for this purpoſe.

This

Fig. 47



This machinery is very ſimple : It conſiſts of the portable boiler and fire-place repreſented in the preceding figure (46.) with an inverted cylindrical veſſel, conſtructed of tin, or of very thin ſheet-copper, placed over the boiler. This cylindrical veſſel, which I ſhall call a STEAM-STOVE, muſt be juſt equal in diameter, to the ſteam-rim of the boiler, at the loweſt or deepeſt part of that rim; and it may be made higher, or lower, according to the ſize of the room that is to be heated by it. That repreſented in the foregoing figure is 26 inches in diameter, and 24 inches high; which gives 17 ſquare feet of ſurface for heating the room.

This *ſteam-ſtove* may be made of common ſheet-iron; but in that caſe it ſhould be japanned within and without, to prevent its ruſting. In japanning it, it might be painted, or gilded, and rendered very ornamental. The portable fire-place might likewiſe be japanned and ornamented; but in that caſe it would be neceſſary to line that part of it with clay or cement, with which the ſmoke comes into contact, otherwiſe the heat, in that part, might injure the japan.

There muſt be a ſmall tube, about ¼ of an inch in diameter, in one ſide of the ſteam-ſtove, juſt above the top of the ſteam-rim of the boiler. This tube ſhould be about two inches in length, and it ſhould project inwards, horizontally, into the cavity of the ſteam-ſtove. Into this tube, one end of another longer tube ſhould be introduced, which is deſigned to carry off the redundant ſteam into the chimney.

The reaſon why this tube ſhould be placed near the bottom of the ſteam-ſtove, will be evident to thoſe who recollect that ſteam is lighter than air. Were it placed at the top of it, no ſteam would remain in the ſtove, and the object of the contrivance would be defeated.

This ſmall ſteam-tube at the lower part of the ſtove may, with ſafety, be kept quite open; for unleſs the water in the boiler be made to boil with vehemence, little or no ſteam will iſſue out of it; for the greater part, if not the whole of it, will be condenſed againſt the top and ſides of the ſteam-ſtove.

As the water which reſults from this condenſation of ſteam, will all return into the boiler, it will ſeldom be neceſſary to repleniſh the boiler with water.

When cooking is going on in the boiler in cold weather, the ſteam-ſtove will ſupply the place of a cover for the boiler; but when the weather is warm, the cover of the boiler may be uſed inſtead of it, and the air of the room will be very little heated.

Steam-ſtoves on theſe principles would be found very uſeful in heating halls and paſſages, and I think they might be uſed with advantage for heating elegant apartments. They are ſuſceptible of a variety of beautiful forms, and are not liable to any objections that I am aware of. A moſt elegant ſteam-ſtove might be made in the form of a doric temple, of eight or ten columns, ſtanding on a pedeſtal. The fire-place might be ſituated in the pedeſtal, and the columns and dome of the temple might be of braſs or bronze, and made hollow to admit the ſteam. In the center of the temple a ſmall ſtatue might be placed, as an ornamental decoration—or an argands lamp might be placed there to light the room. In caſe a lamp ſhould be placed in the center of the temple, there ſhould be a circular opening left in the top of the dome for the paſſage of the ſmoke of the lamp.

The fire under the boiler may be lighted and fed without the room, or within it; or the ſteam may be brought from a diſtance in a leaden pipe or copper tube. If the boiler that ſupplies the ſteam is ſituated in the pedeſtal of the temple, and if the fire is lighted from within the room, the fire-place and aſh-pit doors may be maſked by tablets and inſcriptions.

But I need not enlarge on the means that may be uſed for rendering an uſeful mechanical contrivance ornamental and expenſive; for many perſons will be ready to lend their aſſiſtance in that undertaking.

Thoſe who wiſh to ſee one of theſe univerſal kitchen boilers, will find one ſet in brick-work, in the kitchen of the Royal Inſtitution. It is conſtructed of copper, and tinned on the inſide; and it is conſiderably larger than that I have here deſcribed. The method uſed for confining the ſteam in this boiler is different from that here recommended; and there is a contrivance for heating the contents of the boiler occaſionally by means of ſteam, which is brought from another boiler; but this contrivance has no particular connection with the invention in queſtion, and is introduced here merely to ſhow how ſteam may be employed for making liquids boil.

In order that theſe univerſal kitchen-boilers, with ſteam-ſtoves, may the more eaſily find their way into common uſe in this country, ſome method ſhould be contrived for making tea in them. Now I think this might be done by putting the tea, with cold water, into a ſhallow tin tea-pot, or rather kettle, and placing it in the upper boiler, directly over the lower boiler. I once made an experiment of this kind; and if I was not much miſtaken, the tea that was ſo made was uncommonly good, and high flavoured. It certainly appeared to be conſiderably ſtronger than it would have been, if, with the ſame quantities of tea and of water, it had been made in the common way.

Boiling water poured upon a vegetable ſubſtance does not always extract from it all that might be extracted, by putting the ſubſtance to cold water, and heating them together. This fact is well known; and it renders it probable that the method here propoſed, of making tea, would be advantageous. If this ſhould be the caſe, no implement could be better contrived for that purpoſe than our univerſal kitchen boiler.

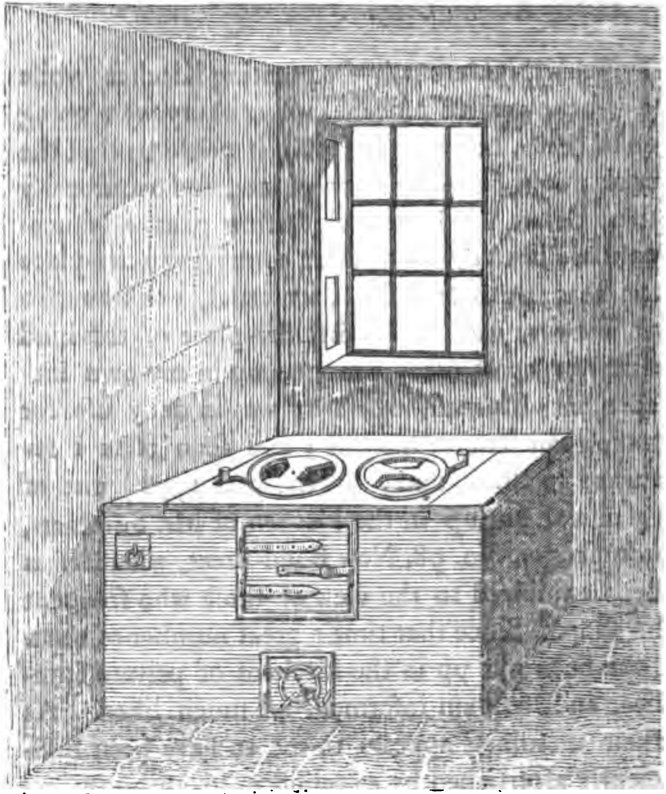
CHAP. X.

Deſcription of a new-invented REGISTER-STOVE *or* FURNACE, *for heating Kitchen Boilers, Stew-pans, &c.—Of the conſtruction of Boilers and Stew-pans, peculiarly adapted to thoſe Stoves.—Particular method of conſtructing Stew-pans and Sauce-pans of Tin, by which they may be rendered very durable.—Deſcription of a ſmall* PORTABLE FIRE-PLACE *for Stew-pans and Sauce-pans.—Of caſt-iron* HEATERS *for heating Kitchen Utenſils.*

HAVING learnt, by frequenting Kitchens while the various proceſſes of cookery were going on in them, how very deſirable it would be that the cook might be enabled to regulate, and occaſionally to moderate the fires by which ſtew-pans and ſauce-pans are heated, I ſet about contriving a fire-place for that purpoſe, which, on trial, was found to anſwer very well. The firſt fire-place of this kind that was conſtructed was put up in my own kitchen, at Munich, where it was in daily uſe for more than twelve months; and ſoon after I returned to this country (in the year 1798.) one of them was put up in the kitchen of Mr. Summers, ironmonger, No. 98, New Bond-ſtreet, where it has been exhibited to the view of thoſe who frequent his ſhop. Since that time a great number of them have been put up in the kitchens of private families, and, as I am informed, are much liked. As their uſefulneſs appears to me to have been ſufficiently aſcertained by experience to authorize me to recommend them to the public, I ſhall now lay before the reader the moſt exact and particular deſcription of them that I can give; premiſing however, that it will be difficult to give ſo clear an account of this contrivance as to enable a perſon to form a perfect idea of it without having ſeen it.

I ſhall perhaps be moſt likely to ſucceed in this attempt, if I begin by exhibiting a view of the thing to be deſcribed.

Fig. 48.



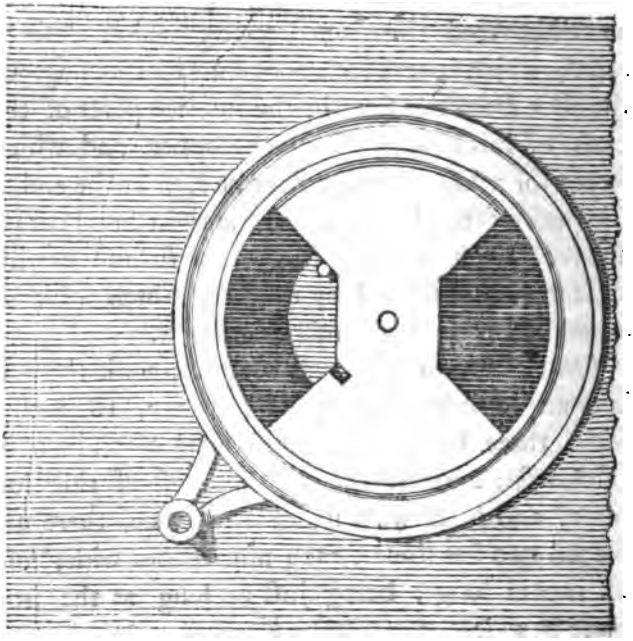
This plate repreſents a view of a regiſter-ſtove fire-place for two ſtew-pans, actually exiſting in Heriot's Hoſpital at Edinburgh. It is placed in a maſs of brick-work, two feet ſix inches high, four feet ſix inches long, and two feet wide, from front to back, ſituated in a corner of the room, on the right hand ſide of the fire-place. In the middle of the front of this maſs of brick-work are ſeen, the front of the fire-place door (which is double)—and the aſh-pit regiſter-door;—and near the end of it, on the left, in the upper front corner, may be diſcovered the ſtone ſtopper, which cloſes a canal, which is occaſionally opened for cleaning out the ſoot from the flues in the interior parts of the maſs of brick-work. A like ſtopper, and which ſerves for a like purpoſe, may be ſeen at the end of the maſs of brick-work, near the right hand corner above. Each of theſe ſtoppers is furniſhed with an iron ring, faſtened by a ſtaple, which ſerves as a handle in removing and replacing it.

On the top of this maſs of brick-work there is laid an horizontal plate of caſt-iron, 18 inches wide, three feet long, and about $\frac{1}{2}$ of an inch in thickneſs; and on the right and left of this iron plate, and level with its upper ſurface, there are placed two flat ſtones, each nine inches wide, and 18 inches long; being juſt as long as the iron plate is wide.

At the back of this iron plate runs a flue, four inches wide and five inches deep, which is covered above, at the level of the upper ſurface of the iron plate, with a flat ſtone, ſix inches wide.

One of the moſt eſſential parts of this contrivance is the iron plate, with its circular regiſter; both which are repreſented by the following figure. In order to give this figure upon the largeſt ſcale the ſpace which it muſt occupy will admit of, only one half of the plate is repreſented, being ſhewn broken off in the middle.

Fig. 49



In this figure the circular moveable regiſter (which is diſtinguiſhed from the oblong plate to which it belongs, by marking the latter by fine horizontal lines) is ſhewn in its place; and the projecting piece of metal is alſo ſeen, which ſerves as a handle to turn it about on its centre. This circular regiſter has a ſhallow circular groove, near its circumference, about ½ an inch deep and 1¼ inches wide; and between the inſide of this groove and the centre of the regiſter there are two holes, or openings, on oppoſite ſides of the centre, which anſwer to two other openings of like form and dimenſions, which are in each half of the oblong plate to which the regiſters belong. By one of theſe openings (that next the middle of the oblong plate) flame riſes from a fire ſituated below, and ſpreads under the bottom of a boiler, which is ſuſpended over the circular regiſter; and by the other it deſcends, and again entering the maſs of brick-work, it goes off by an horizontal canal which communicates with the chimney.

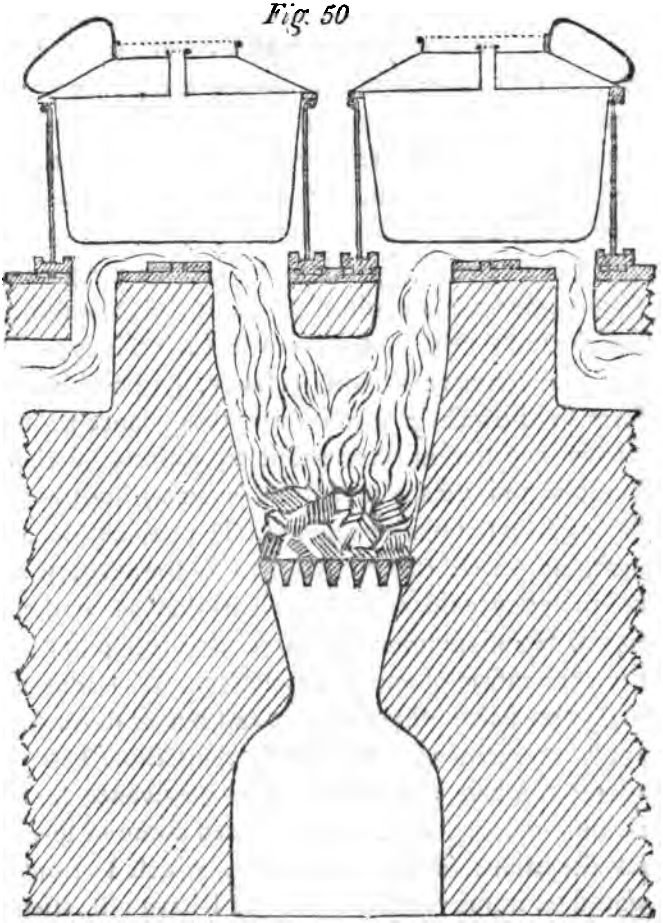
The boiler, or ſtew-pan is ſuſpended over the circular regiſter-plate, and the heat is confined about it by means of an hollow cylinder of ſheet-iron, or of earthen ware (about one inch longer, or higher than the boiler is deep) and open at both ends; the lower end of which entering the ſhallow groove of the regiſter, repoſes on it, while its upper end is cloſed by the boiler, which, reſting on it by its brim, is ſuſpended in it, and conſequently is ſurrounded by the flame.

This cylinder muſt be made quite flat, or even at its two ends, by grinding it on a flat ſtone; and the boiler muſt be made to fit it accurately, not however by fitting too nicely into its opening (which method would not be adviſeable)—but by making the under part of the iron ring, which forms the projecting brim of the boiler, perfectly flat, and cauſing the boiler to be ſuſpended by that ring on the flat end of the cylinder.

To prevent the eſcape of the flame under the bottom of the cylinder, or between its lower end and the circular regiſter-plate on which it ſtands, a ſmall quantity of ſand, or (what will be ſtill better) of fine filings of iron or braſs, may be put into the groove in which the cylinder is placed: and the ſame means may be uſed for making the joinings tight between the circular regiſters and the flat plate to which they belong.

The following figure, which ſhews a vertical ſection of this regiſter-ſtove, with its fire-place and its two boilers, or rather ſtew-pans, will give a clear idea of the arrangement of the machinery.

Fig. 50



Theſe ſtew-pans, which are 10 ½ inches in diameter above, and 6 inches deep, each, are conſtructed according to the directions given in the ſeventh chapter of this Eſſay. They are of copper, tinned, and are turned over flat iron rings at their brims.

Their handles are not ſeen in this figure, having been omitted for want of room. Their covers, which are of tin, and made double, are on a peculiar conſtruction. They are ſo contrived that a ſmall ſauce-pan for melting butter, or warming gravy, may be placed upon them, and heated by the ſteam from their ſtew-pans.

From a careful inſpection of the three foregoing figures, and a compariſon of them with the ſhort deſcription that has been given of the various parts of this machinery, it will, I fancy, be poſſible to form ſo diſtinct an idea of this contrivance as to enable any perſon, converſant in matters of this kind, to imitate the invention, even without ever having ſeen the work executed. The principles, at leaſt, on which this contrivance is founded, will be perfectly evident; and when they are underſtood, ingenious men will find little difficulty in the application of them to practice. It is indeed highly probable that ſimpler and better means of applying them will be found, than thoſe I have adopted, when the uſe of the contrivance ſhall become more general. I am indeed aware of ſeveral alterations of the machinery, which I think would be improvements; but as I have not tried them, I dare not recommend them, as I recommend things which I know from experience to be uſeful.

I ſhall now proceed to give an account of ſeveral precautions in the conſtruction and uſe of theſe regiſter-ſtoves for boilers, which have been found to be neceſſary and uſeful.

The circular regiſters are ſo conſtructed, that by turning them round, they may be ſo placed as either to cloſe entirely the holes in the flat plate on which they lie, or to leave them open more or leſs. Now as there is no paſſage, by which the ſmoke can go off from the fire-place into the chimney, but through theſe holes, care muſt be taken never to attempt to kindle the fire when both theſe regiſters are cloſed;—and never to open one of them without having firſt placed an hollow cylinder on it, and a fit ſauce-pan or boiler in the cylinder, to cloſe it above. It can hardly be neceſſary that I ſhould add, that care muſt always be taken to put water, or ſome other liquid, into the boiler, to prevent its being burnt and ſpoiled by the heat.

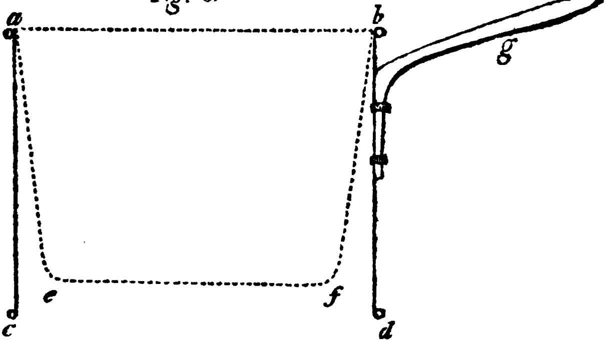
The ſtate of the regiſter—in regard to its being more or leſs open—cannot be ſeen when the boiler is in its place, as the openings of the regiſter are concealed by it, and by the cylinder in which it is ſuſpended. But although the ſtate of the regiſter under theſe circumſtances, is not *ſeen*, it is nevertheleſs *known*; and the heat which depends on the dimenſions of the opening left for the paſſage of the flame, may, at any time, be regulated with the utmoſt certainty. By means of a projecting pin, or ſhort ſtub, repreſented in the figure 49, belonging to the lower (fixed) plate—and which is caſt with it—the moveable circular regiſter is ſtopped in two different poſitions; in one of which the openings for the flame are as wide as poſſible, and in the other they are quite cloſed. When the handle, by which the circular plate is turned round, is pulled as far forward as poſſible towards the front of the brick-work, the regiſter is wide open. In this ſituation it is repreſented in the figure 49. When it is puſhed as far backwards as poſſible, the regiſter is cloſed; and its ſituation at any intermediate ſtation of the handle, between theſe two limits of its motion, will at any time ſhew the exact ſtate of the regiſter.

That the handles of the regiſter plates may not interfere with each other, they are placed on the ſides of their plates, which are fartheſt from the fire; conſequently they are as far from each other as poſſible. The form of theſe handles is ſuch that they never become very hot, although they are of iron, and of a piece with their plates, being caſt together. The cold air of the atmoſphere paſſing freely upward through a conical hole (left in caſting) in the center of the knob of the handle, the heat is carried off by this current of air, almoſt as faſt as it arrives from the circular plate.

There is a circumſtance to which it is abſolutely neceſſary to pay attention in ſetting the large flat iron plate in the brick-work, otherwiſe the machinery will be liable to be ſoon deranged, by the effects of the expanſion of the metal by heat:— The bottom, or under ſide of this plate muſt be every where completely covered and defended from the action of the flame by bricks or tiles. This is very eaſy to be done, but, at the ſame time, as it requires ſome care and attention, it is what workmen are very apt to neglect, if they are not well looked after.—As this plate is very large, if great care be not taken to prevent its being expoſed to the flame, it will ſoon be warped and thrown out of its place. If, inſtead of caſting this plate in one piece, it be formed of two pieces, each 18 inches ſquare, the bad effects produced by the expanſion of the metal by heat will be greatly leſſened; and this precaution has been taken in moſt of the regiſter-ſtoves on theſe principles that have been put up in London; but by an experiment lately made at Heriot's hoſpital at Edinburgh, I have been convinced that the large plates may be depended on, if they are properly ſet.

I have deſcribed the cylinder in which the ſtew-pan or boiler is ſuſpended, as being a ſeparate thing:—it is right, however, that I ſhould inform the reader, that in almoſt all caſes where regiſter fire-places of this kind have hitherto been put up, this cylinder has been firmly and inſeparably united to the ſtew-pan, ſo much ſo as to make a part of it, the handle even being attached to this cylinder, inſtead of being joined immediately to the ſtew-pan. The following figure, which repreſents a vertical ſection of one of theſe ſtew-pans, and its cylinder, will ſhew how they have hitherto generally been conſtructed.

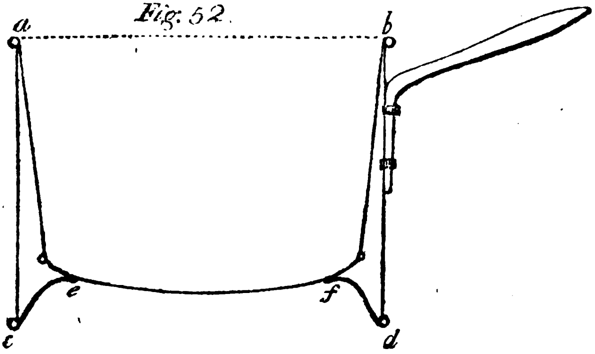
Fig. 51



a, *b*, *c*, *a*, repreſents a vertical ſection of the cylinder, which is 11 $\frac{1}{2}$ inches in diameter, and 8 inches high. Into this cylinder, which is open at both ends, the boiler or ſtew-pan, *a*, *e*, *f*, *d*, (which is diſtinguiſhed by dotted lines) is made to paſs with ſo much difficulty, as to require a conſiderable force to bring it into its place, and not to be in danger of being ſeparated from it by any accidental blow. The handle *g*, is rivetted to the cylinder previouſly to its being united to its ſtew-pan.

It having been found that this cylinder was liable to become very hot, and even to be deſtroyed by the heat in a ſhort time, if care was not taken to keep the fire low; and it having likewiſe been found that the heat that made its way upwards, between the outſide of the ſtew-pan and the inſide of the cylinder, frequently heated the upper part of the ſtew-pan ſo intenſely hot, as to cauſe the victuals cooked in it to be burnt to the ſides of the ſtew-pan, eſpecially when the ſtew-pan was almoſt empty. With a view to remedy both theſe evils, and at the ſame time to conſtruct ſtew-pans and ſauce-pans of large dimenſions of common ſheet-tin (tinned iron) which ſhould be more durable, and ſuperior in many reſpects to thoſe of that material now in common uſe, ſome alterations were made in this utenſil, which will be eaſily underſtood by the help of the following figure.

Fig: 52.



In order to prevent the flame from paſſing upwards between the ſauce-pan and its cylinder, and occupying the vacant ſpace, *c*, *a*, *e*, this ſpace was incloſed by means of a circular piece of ſheet-copper, *c*, *e*, *f*, *d*, with a large circular opening in its center, of the diameter, *e f*. This copper being a little larger in diameter than the cylinder, was firmly attached to it all round, by being turned over the ſame wire which ſtrengthened and made a finiſh to the bottom of the cylinder; while the inſide edge, *e*, *f*, of this circular perforated ſheet of copper being raiſed upwards, with the hammer, about an inch, as it is repreſented in the figure, the ſauce-pan is made of ſuch a form, that, on being brought into its place, its bottom is forced down upon the upper edge of this copper; by which means the empty ſpace between the ſauce-pan and its cylinder is cloſed up below by the copper, and the flame prevented from entering it. Sheet-iron might have been uſed inſtead of ſheet-copper, for cloſing up this ſpace; but copper was preferred to it on account of its not being ſo liable as iron to be deſtroyed by the action of the flame.

This contrivance was found to anſwer ſo well for preventing the cylinder from being deſtroyed by heat, that, when it was made of tinned ſheet-iron, (commonly, but improperly, called tin) the tin, by which the ſurface of the iron was covered, was not melted by it: and ſo completely did it prevent the ſides of the ſauce-pan from becoming too hot, that a quantity of fluid, of any kind, ſo ſmall as barely to cover the bottom of the veſſel, might be boiled in it, without the ſmalleſt danger of its being burnt to its ſides.

Having found that the ſides of the ſauce-pan were ſo effectually defended by this contrivance from intenſe heat, it occurred to me that a ſauce-pan of common tin might perhaps be ſo conſtructed, as, with this precaution for the preſervation of its ſides, it might be made to laſt a great while; which would not only ſave a conſiderable expence for kitchen utenſils—tin being much cheaper than copper—but would alſo remove the apprehenſion of being poiſoned by any thing injurious to health, communicated to the food by the veſſel in which it is prepared; which thoſe cannot help feeling, who eat victuals cooked in copper utenſils, and who know the deleterious qualities of that metal.

Concluding that if I could contrive to prevent the ſeams or joinings of the tin, in a ſauce-pan or boiler, from ever coming into contact with the flame of the fire, it could not fail to contribute greatly to the durability of the utenſil; I cauſed the ſauce-pan, repreſented in the foregoing figure, to be made of that material. The bottom of this ſauce-pan, *e*, *f*, was made diſhing (inſtead of being flat, as the bottoms of tin ſauce-pans are commonly made) and being joined to the body of the ſauce-pan by a ſtrong double ſeam, the vacuities of the ſeam, both within and without, were well filled up with ſolder.

Now as care was taken in adjuſting the conical band of copper *c*, *e*, *f*, *d*, to the bottom of the ſauce-pan, to make its circular opening above, at *e*, *f*, ſomething leſs in diameter than the bottom of the ſauce-pan at its extreme breadth, or where it joins the ſides or body of the utenſil; and alſo to cauſe the upper edge of this copper actually to touch the bottom of the ſauce-pan, and even to preſs againſt it in every part of its circumference, it is evident that the ſeam, by which the body of the ſauce-pan and its diſhing bottom were united, was completely covered by the copper, and defended from the intermediate action of the fire: it is likewiſe evident, that the ſide-ſeams in the body of the ſauce-pan, were likewiſe protected moſt effectually from all the deſtructive effects of intenſe heat: and if care were taken to cover the outſide of the body of the ſauce-pan with a good thick coating of japan, to prevent its being injured by ruſt, there is little doubt but that ſauce-pans ſo conſtructed would laſt a long time indeed.

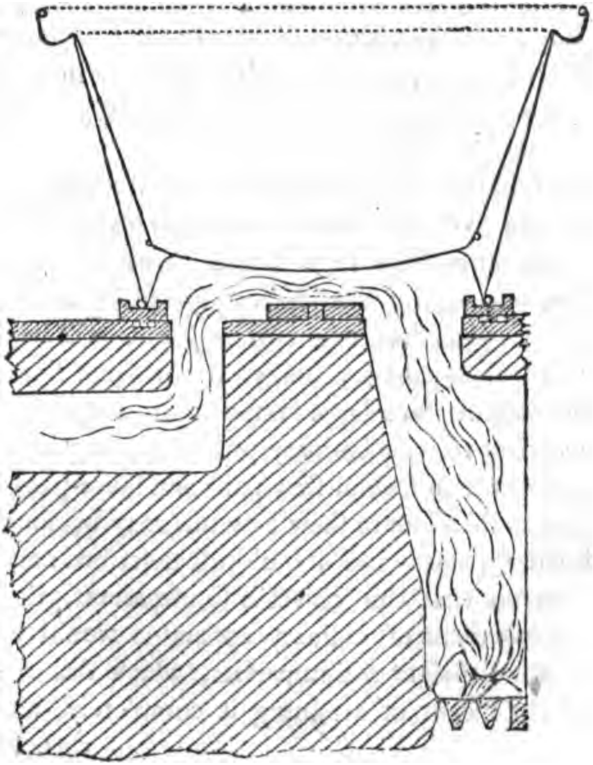
The cylinder in which the ſauce-pan is ſuſpended might likewiſe be japanned—both within and without—which would not only preſerve it from ruſt, but would alſo give it a very neat appearance. All theſe improvements have been made, and a variety of ſauce-pans conſtructed on the principles here recommended may be ſeen in the Repoſitory of the Royal Inſtitution.

Of the means that may be employed for uſing indifferently Sauce-pans and Boilers of different ſizes, with the ſame Regiſter-Stove Fire-place.

Although the diameter, below, of the cylinder or cone (for it may be either the one or the other) in which the ſauce-pan or boiler is ſuſpended, is limited by the diameter of the groove of the circular regiſter-plate in which it ſtands over the fire; yet, the ſizes of the cooking utenſils uſed with them may be greatly varied. They may, without the ſmalleſt inconvenience, be made either broader or narrower above at their brims, than the bottom of the cylinder or cone in which they are ſuſpended; and, with any given breadth above, their depths (and conſequently their capacities) may be varied almoſt at pleaſure. When, however, the diameter of one of theſe boilers, at its brim, is greater than the diameter of the groove of the regiſter-plate of the fire-place, it muſt be ſuſpended in an inverted hollow cone, and its body muſt neceſſarily be made conical.

The following figure ſhews how a boiler, 15 inches in diameter, with a ſteam-rim (with which the ſteam-diſhes of a 15 inch family boiler may occaſionally be uſed) may be adapted to a regiſter-ſtove fire-place of the uſual dimenſions.

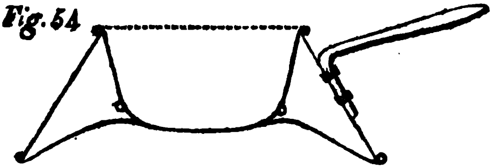
Fig. 53



This boiler requires no handle, as its ſteam-rim may be uſed inſtead of a handle in moving it from place to place.

The following figure ſhews how very ſmall ſauce-pans are to be fitted up, in order to their being uſed with theſe regiſter-ſtove fire-places.

Fig. 54



This ſauce-pan is only ſix inches in diameter, at its brim, and three inches deep. The hollow cone in which it is ſuſpended is about ſix inches in diameter above—10½ inches in diameter below—and four inches in height.

In kitchens of a moderate ſize it will ſeldom be convenient to devote more ſpace for ſtoves for ſtew-pans and ſauce-pans than would be neceſſary for erecting one regiſter ſtewing-ſtove fire-place, which, if the fire-place has only two regiſters, will heat only two ſtew-pans or boilers at the ſame time; but in cooking for a large family it will frequently be neceſſary to have culinary proceſſes going on at the ſame time in ſeveral ſtew-pans and ſauce-pans; it remains therefore to ſhew how this may be done, with the apparatus and utenſils juſt deſcribed: and it is certain that this object is ſo important, that any arrangement of culinary apparatus would be eſſentially deficient and imperfect, which did not afford the means of attaining it completely, and without any kind of difficulty. There are two ways in which it may be done with the utenſils above deſcribed : A ſtew-pan or ſauce-pan having been placed upon one of the regiſter-plates of the ſtove till its contents are boiling hot, it may be removed, and placed over a very ſmall fire made with charcoal in a ſmall portable furnace reſembling a common chafing diſh ;—or it may be ſet down upon a circular iron heater, made red hot, and placed in a bed of dry aſhes, in a ſhallow earthen pan. By either of theſe methods a boiling heat may be *kept up* for a long time in the ſtew-pan ; and any common proceſs of boiling or ſtewing carried on in a very neat and cleanly manner. It muſt however be remembered, that it is only with ſtew-pans and boilers conſtructed on the principles here recommended, and conſtantly kept well covered, with double covers, to prevent the loſs of the heat, that the proceſſes of boiling and ſtewing can be carried on with very small portable furnaces, and with heaters ; but with theſe utenſils, which are ſo well calculated to confine the heat, it is almoſt incredible how ſmall a ſupply of heat will be ſufficient, when the contents of the veſſel have previouſly been made boiling hot, to keep up that temperature, and carry on any of the common proceſſes of cookery.

In the following figure (55.) A, repreſents a vertical ſection of a ſtew-pan, 11 inches wide at its brim, and 6 inches deep, ſuſpended in its cylinder,

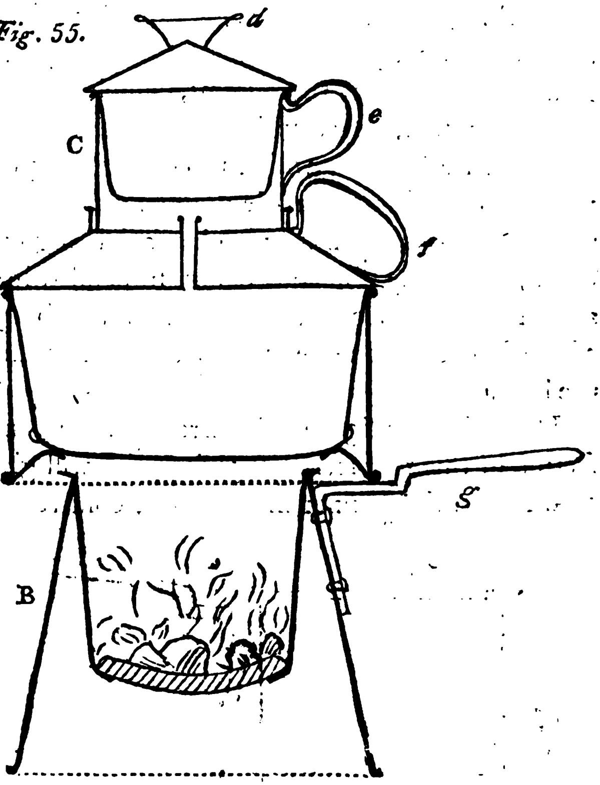
and

and placed upon a *portable furnace*, B, which is 7 inches in diameter at its opening above, 11 inches in diameter below, and 9 inches high. A ſmall ſauce-pan, C, for melting butter, is placed on the cover of the ſtew-pan, and is heated by the ſteam from the ſtew-pan.

This ſmall ſauce-pan is ſuſpended in a cylinder, which ſerves for confining the ſteam about it, which riſes from the ſtewing ſtove.

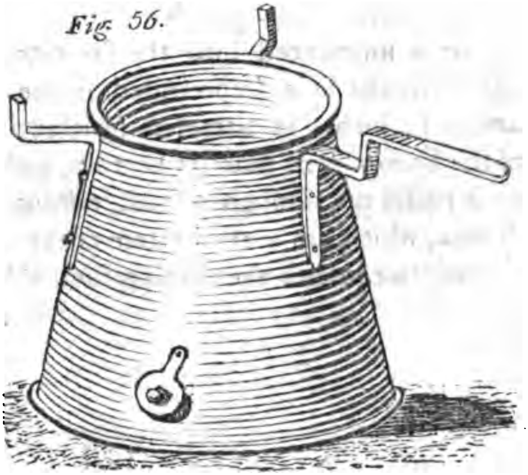
The cover of this ſmall ſauce-pan is double, and, inſtead of an handle, it is furniſhed with a kind of a knob *(d)* formed of an hollow inverted cone of tin, which occaſionally ſerves as a foot for ſupporting the cover, when it is taken off from the ſauce-pan, and laid down in an inverted poſition. This contrivance is deſigned to prevent the inſide of the cover from being expoſed to dirt, when it is occaſionally taken off, and laid down. The ſauce-pan is furniſhed with a handle of the common form *(e)* which is repreſented in the figure.—The handle *(f)* of the ſtew-pan is alſo ſhewn; and that *(g)* of the portable fire-place.

Fig. 55.



The following figure is a perſpective view of the portable furnace, without the ſtew-pan:

Fig. 56.

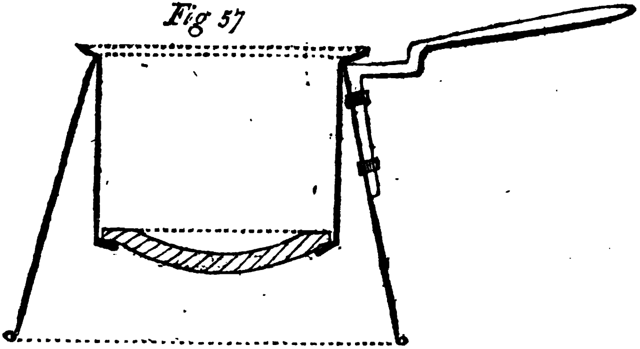


In this figure the three horizontal projecting arms are diſtinctly ſeen, which ſerve to ſupport the ſtew-pan. One of theſe arms, which is longer than the reſt, ſerves as an handle to the furnace.

This little furnace, which is conſtructed principally of ſheet-iron, is made double, that part of it which contains the burning charcoal being cylindrical, or nearly ſo, and being ſuſpended in the axis of an hollow cone, which forms the body of of the furnace, and ſerves as a covering for confining the heat.

The following figure, which repreſents a vertical ſection of this furnace through its axis, will give a clear idea of the manner in which it is conſtructed.

Fig 57



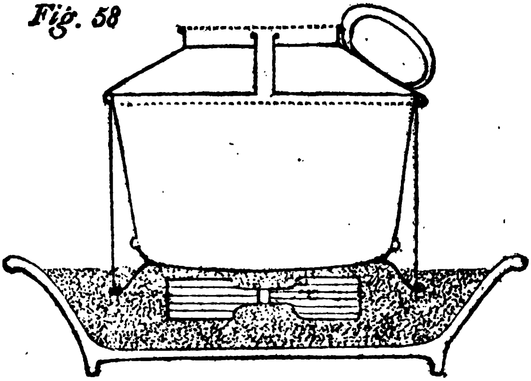
The air is introduced into the fire-place, firſt through a circular hole (repreſented in the figure 56.) about 1½ inches in diameter, ſituated in the ſide of the hollow cone near its bottom; and from thence it paſſes up through a ſmall diſhing grate of caſt-iron, which lies at the bottom of the hollow cylinder which contains the burning fuel. At the upper end of this cylinder there is a narrow rim, about half an inch wide, turned outwards, by which the cylinder is ſuſpended in its place; and a ſimilar rim being turned inwards below, ſerves as a ſupport for the diſhing grate.

When this fire-place is uſed, it will be proper to place it on a flat ſtone, or on a tile; or, what will be ſtill better, to ſet it in a thin earthen diſh.

The ſame earthen diſhes which would be proper for holding theſe portable fire-places, would alſo anſwer perfectly well for holding the caſt-iron heaters that may occaſionally be uſed for finiſhing the proceſſes of cooking that have been begun in ſtew-pans and ſauce-pans, heated over the fire of a regiſter-ſtove, or otherwiſe made boiling hot.

The following figure, which repreſents a vertical ſection of a ſtew-pan, placed over a heater of the kind here recommended, will give a perfect idea of this arrangement.

Fig. 58

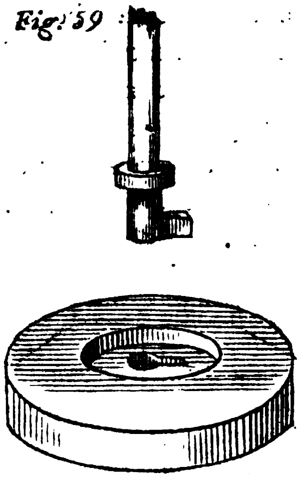


The heater is here repreſented as lying in a bed of aſhes, and there is likewiſe a thin layer of aſhes ſeen between the top of the heater and the bottom of the ſtew-pan. By the quantity of aſhes ſuffered to remain on the upper ſurface of the heater, the heat communicated to the ſtew-pan is to be moderated, and regulated.

The heater is perforated in its center, by a hole of a peculiar form, which ſerves for introducing an iron hook, which is uſed in taking it from the fire, and placing it in the earthen diſh.

The form of the hook, and the ſhape of the aperture through which it paſſes in the heater, may be ſeen in the following figure:

Fig. 59



The circular excavation in the heater, on each ſide of it, ſurrounding the hole (which is in the form of the key-hole of a lock) by which the hook is introduced, ſerves to give room for the hook (or key, as it might be called) to be turned round when the heater is laid upon, or againſt a flat ſurface. As this excavation, as well as the hole through which the key paſſes, may be caſt with the heater, this arrangement will cauſe no additional expence.

CHAP.

CHAP. XI.

Of the uſe of PORTABLE FURNACES, *for culinary purpoſes.—Deſcription of a portable Kitchen Furnace, for Boilers, &c. on the common conſtruction.—Deſcription of a ſmall Portable Furnace of caſt-iron, for heating tea-kettles, ſtew-pans, &c.—Deſcription of another, of ſheet-iron, deſigned for the ſame uſes.—Deſcription of a Portable Kitchen Furnace of earthen ware.—An account of a very ſimple Apparatus for Cooking, uſed in China.*

IN China, and in ſeveral other countries, all, or nearly all the fire-places uſed in cooking are portable; and real advantages might certainly be derived, in many caſes, from the uſe of portable kitchen fire-places in this country. Convinced of the utility of this method of cooking, I have taken conſiderable pains to inveſtigate the ſubject experimentally, and to aſcertain the beſt forms for the furnaces and utenſils neceſſary in the practice of it.

Portable furnaces for cooking are of two diſtinct kinds : The one has a fire-place door for introducing the fuel—the other has none : and either of theſe may, or may not, be furniſhed with a tube for carrying off the ſmoke into the air, or into a neighbouring chimney.

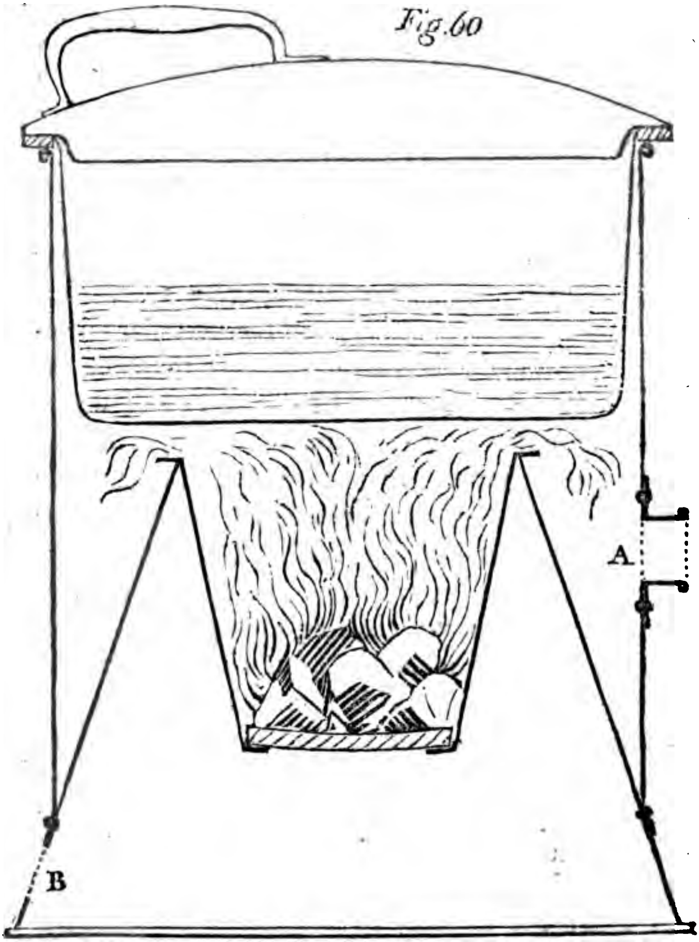
When a portable kitchen furnace is conſtructed without a fire-place door, as often as fuel is to be introduced, it will be neceſſary to remove the boiler, in order to perform that operation. When the boiler is ſmall, that may eaſily be done ;

done; and when the furnace ſtands out of doors, or on the hearth within the draft of a chimney, or when the fuel uſed produces little or no ſmoke, it may be done without any conſiderable inconvenience; but if the boiler be large, it cannot be removed without difficulty; and when the furnace is placed within doors, and the fuel uſed produces ſmoke, or other noxious vapours, the removing of the boiler, though it were but for a moment, would be attended with very diſagreeable conſequences.

Small portable furnaces, without fire-place doors, may may be uſed within doors, provided they be heated with charcoal; but it will in that caſe always be adviſable to furniſh them with ſmall tubes of ſheet-iron, for carrying off the unwholeſome vapour of the charcoal into the chimney. Without ſuch tubes to carry off the ſmoke, they would not, it is true, be more diſagreeable, or more detrimental to health, than the ſtoves now generally uſed for burning charcoal in kitchens; but I ſhould be ſorry to recommend an invention to which there appear to me to be ſo great objections.

I have cauſed a conſiderable number of portable kitchen furnaces, of both the kinds above-mentioned, to be conſtructed; and I ſhall now give deſcriptions of ſuch of them as ſeem to anſwer beſt the purpoſes for which they were deſigned. They may all be ſeen at the Repoſitory of the Royal Inſtitution, A very ſimple and uſeful portable kitchen furnace, with its ſtew-pan in its place, are repreſented by the following figure :

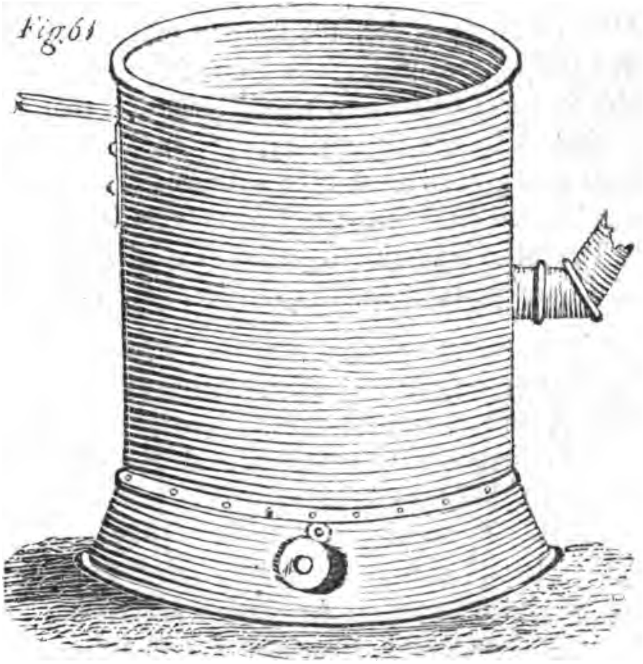
Fig. 60



This furnace is made of common ſheet-iron, and it may be afforded at a very low price. It is compoſed of an hollow cylinder, and two hollow truncated cones of different ſizes. The large cone, which is erect, is cloſed at its baſe, or lower end: The ſmaller is inverted, and is open at both ends. This ſmaller cone is ſuſpended in the larger, by means of a rim about half an inch wide, which projects outwards from its upper (larger) end. A rim of equal width, projecting inwards, at its lower extremity, ſupports a circular grate, on which the fuel burns. The cylinder, which is about two inches leſs in diameter than the larger cone at its baſe, and which reſts upon the ſurface of that cone, ſerves to ſupport the boiler or ſauce-pan. This cylinder is firmly fixed to the cone on which it reſts, by means of rivets, two of which are repreſented in the figure. The upper end of this open cylinder is ſtrengthened, and its circular form preſerved by means of a ſtrong iron wire, over which the ſheet-iron is turned. There is a ſhort horizontal tube (A.) on one ſide of the cylinder, which is deſtined for receiving a longer tube which carries off the ſmoke. The air neceſſary for the combuſtion of the fuel is admitted through a circular hole (B.) about 1¼ inches in diameter, in the ſide of the larger cone, near its bottom, and below the joining of the cone with the cylinder which reſts on it. This hole for the admiſſion of air ſhould be furniſhed with a regiſter, by means of which the fire may be regulated. The handle of the ſtew-pan is omitted in this plate, for want of room, as is alſo that of the fire-place. This figure is drawn to a ſcale of four inches to the inch.

The following figure (which is drawn to a ſcale of ſix inches to the inch) is a perſpective view of one of theſe portable furnaces, without its ſtew-pan.

Fig. 61

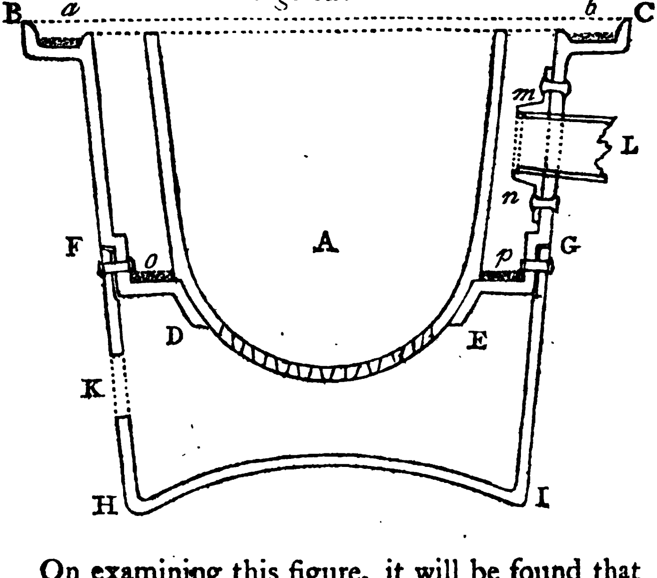


A part of the handle of this furnace is ſeen on the left hand; and the ſhort tube is ſeen on the right hand, that receives another tube, (a part of which only is ſhewn) by which the ſmoke paſſes off.

The ſtew-pan repreſented in the 60th figure, is ſuppoſed to be made of copper, and to be conſtructed on the principles recommended in the ſeventh chapter of this (tenth) Eſſay. Theſe portable furnaces are peculiarly adapted to kitchen utenſils, conſtructed on thoſe principles, and alſo to boilers and ſtew-pans with ſteam-rims, which are not made double; but for double or *armed boilers*, ſtew-pans, &c. the furnace muſt be made in a different manner. The ſimpleſt form for portable furnaces adapted to armed boilers, is that repreſented by the figures 55, 56, and 57: but I ſhall now give an account of a furnace of this ſort, conſtructed on different and better principles.

The following figure repreſents a vertical ſection of a ſmall portable kitchen furnace, of *caſt-iron:*

Fig. 62.



On examining this figure, it will be found that care has been taken in contriving this furnace, to divide it in ſuch a manner into parts, and to give to thoſe parts ſuch forms as to render the whole of eaſy conſtruction. It conſiſts of three principal parts, namely, of the fire-place A, which is a hollow cylinder, or rather an inverted hollow truncated cone, 7 inches in diameter above, meaſured internally; 4 inches long, or high, ending below with a hemiſpherical hollow bottom, 6 inches in diameter, perforated with many holes for the admiſſion of air.

This fire-place is ſuſpended in the axis of the furnace by means of the projecting hollow ring D, E, belonging to the upper and principal piece, B, C, D, E, of the furnace. At the upper part of this piece there is a circular cavity, *a*, *b*, about one inch wide, and a quarter of an inch deep, which is deſtined to receive the lower extremity of the hollow cylinder in which the boiler is ſuſpended. At L, is a circular hole 1 ¼ inches in diameter, which receives the end of the tube by which the ſmoke is carried to the chimney. A part of this tube, which is of ſheet-iron, is repreſented in the figure. To give it a more firm ſupport in its place, there is a ſhort tube, *m*, *n*, of caſt-iron, which projects inwards into the furnace about ⅝ of an inch. This ſhort tube is caſt with a flanch, and it is faſtened to the inſide of the piece which conſtitutes the upper part of the body of the furnace, by means of three or four rivets. Two of theſe rivets are diſtinctly repreſented in the figure.

The lower part of the body of the furnace conſiſts of the piece F, G, H, I, and it is faſtened to the upper part by means of rivets, two of which are ſeen at F. and at G. In one ſide of this lower part there is a circular hole at K, about 1 ¼ inches in diameter, which ſerves for the admiſſion of air, and which is furniſhed with a regiſter ſtopper. The bottom of this furnace, inſtead of being made flat is ſpherical, projecting upwards; which form was choſen in order to prevent, as much as poſſible, the heat from the fire from being communicated downward. This furnace will require no handle, as its projecting brim will ſerve inſtead of one.

It will be obſerved, that all the pieces of which this furnace is compoſed, are of ſuch forms that the moulds for caſting them will readily deliver from the ſand; and that circumſtance will contribute greatly to the lowneſs of the price at which this moſt uſeful article of kitchen furniture may be afforded.

The perforated caſt-iron bowl, A, which conſtitutes the fire-place, is not confined in its place, and its form and its poſition are ſuch that its expanſion with heat can do no injury to the outſide of the furnace.

When the two pieces which form the body of the furnace are faſtened together, their joinings may be made tight with cement.

A little fine ſand ſhould be put into the hollow rim, *a*, *b*, of the furnace, in order that it may be perfectly cloſed above by the lower end of the hollow cylinder of its boiler; and a little ſand or aſhes may be thrown upon the bottom of the circular cavity *o*, *p*, into which the ſmoke deſcends, before it goes off by the tube L, into the chimney. This laſt precaution will prevent the air from making its way upwards from the aſh-pit directly into the cavity *o*, *p*, occupied by the ſmoke, without paſſing through the fire-place.

The regiſter ſtopper to the opening K, into the aſh-pit, may be conſtructed on the ſame principle as that of the blow-pipe of a roaſter. One of theſe ſtoppers is repreſented on a large ſcale in the figure 17, at the end of the ſecond part of this (tenth) Eſſay; or what will be ſtill more ſimple, and quite as good, the admiſſion of the air may be regulated by a regiſter like that repreſented in the preceding figure, No. 61.

This portable kitchen furnace will anſwer a variety of uſeful purpoſes; and, if I am not much miſtaken, it will come into very general uſe. It is cheap and durable, and not liable to be broken by accidents, or put out of order; and it is equally well adapted for every kind of fuel. No particular care or attention is required in the management of it, and it is well calculated for confining heat, and directing it.

As the fire-place belonging to this furnace is nearly inſulated, and as it contains but a ſmall quantity of matter to be heated, a fire is eaſily and expeditiouſly kindled in it; and the fuel burns in it under the moſt favourable circumſtance.

It will be found extremely uſeful for boiling a tea-kettle, eſpecially in ſummer; when a fire in the grate is not wanted for other purpoſes; and, when the tea-kettle is conſtructed on the principles that will preſently be deſcribed, a very ſmall quantity indeed of fuel will ſuffice.

But the moſt important uſe to which theſe portable furnaces can be applied, is, moſt undoubtedly, for cooking for POOR FAMILIES. I have hinted at the probable utility of a contrivance of this kind in ſome of my former publications, but ſince that time I have had opportunities of examining the ſubject more attentively, and of aſcertaining the fact by the teſt of actual experiment.

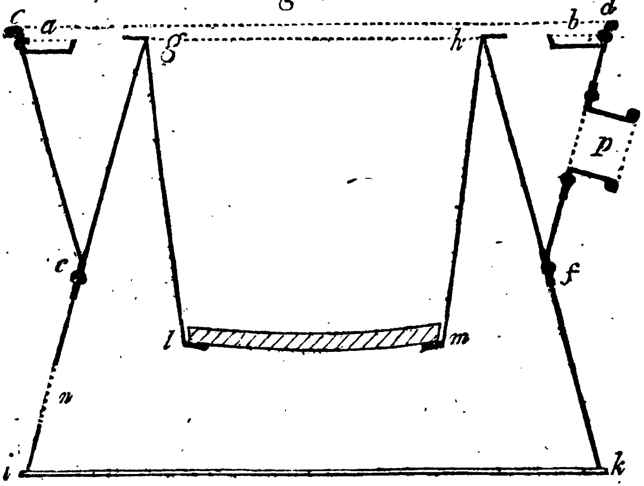
As the ſubject ſtrikes me as being of no ſmall degree of importance, I ſhall make no apology for enlarging on it, and giving the *moſt particular account* of ſeveral kinds of *portable kitchen furnaces.*

That juſt deſcribed (of caſt-iron) is, it is true, as perfect in all reſpects as I have been able to make it, and will probably be found to be quite as economical and as uſeful as any that I ſhall deſcribe; but caſt-iron is not every where to be found, and even where founderies are eſtabliſhed for caſting it, moulds muſt be provided, and theſe are expenſive, and not eaſy to be had. As it is probable that ſome perſons may be deſirous of being provided with portable furnaces of this kind, who may not have it in their power to procure them of caſt-iron, I ſhall now ſhew how they may be conſtructed (by any common workman) of ſheet-iron, and alſo how they may be made of earthen-ware.

Of ſmall Portable Kitchen Furnaces conſtructed of ſheet-iron.

The following figure repreſents a vertical ſection of one of theſe furnaces, drawn to a ſcale of 4 inches to the inch.

Fig. 63



The conſtruction of this furnace will be eaſily underſtood from this figure. The circular hollow horizontal rim *a*, *b*, which I ſhall call the *ſand rim*, is $8\frac{8}{10}$ inches in diameter within, and $12\frac{4}{10}$ inches in diameter without. Its width at its bottom, which is flat, is juſt 1 inch. Its ſides are ſloping, and of different heights; that which is towards the center of the furnace is $\frac{1}{4}$ of an inch high; but the ſide which is outwards is $\frac{1}{2}$ an inch in height.

The ſand-rim is confined and ſupported in its place by being faſtened by means of rivets or otherwiſe, to an inverted hollow truncated cone, *c*, *d*, *e*, *f*, which forms the upper part of the body of the furnace. This inverted cone, which is turned over a ſtrong circular iron wire at its upper edge, *c*, *d*, is 12 $\frac{4}{10}$ inches in diameter above, meaſured within the wire, and 5 $\frac{4}{10}$ inches in height, meaſured from *c* to *e*, or from *d* to *f*; and is 9 $\frac{4}{10}$ inches in diameter, from *e* to *f*, where it is faſtened to the erect hollow truncated cone, *g*, *h*, *i*, *k*.

This laſt mentioned erect cone, which is cloſed below by a circular plate of ſheet-iron, forms the lower part of the body of the furnace: it is 7 inches in diameter above, 12 inches in diameter below, and its perpendicular height is juſt 9 inches. Its ſloping ſide, *g*, *i*, meaſures about 9 $\frac{6}{10}$ inches.

The *fire-place* of this little portable furnace is an inverted hollow truncated cone, *g*, *h*, *l*, *m*, which is 7 inches in diameter above, at *g*, *h*; and 5 $\frac{1}{4}$ inches in diameter below, at *l*, *m*; and its length is 6 $\frac{1}{2}$ inches, meaſured from *g* to *m*. This conical fire-place has a flat rim above, which is $\frac{1}{2}$ an inch wide, and turned outwards; and another below of equal width, which is turned inwards. The firſt ſerves to ſuſpend it in its place; the ſecond ſerves to ſupport its circular grate, on which the fuel burns.

The air is admitted into the fire-place through a hole, *n*, about 1 $\frac{1}{4}$ inches in diameter, in the ſide of the furnace. This aperture muſt be furniſhed with a regiſter ſimilar to that ſhewn in the figure 61.

The proviſion for carrying off the ſmoke is ſimilar in all reſpects to that uſed in the portable furnace above deſcribed, conſtructed of caſt-iron; and it will eaſily be underſtood, from a bare inſpection of the figure (63), without any farther explanation.

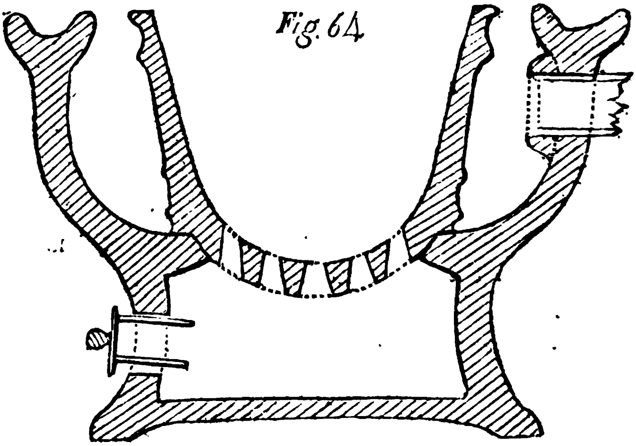
Having ſhewn how this portable kitchen furnace may be conſtructed of caſt-iron, and alſo how it may be made of ſheet-iron, I ſhall now ſhew how it may be made, partly of caſt-iron, and partly of ſheet-iron. A fire-place of caſt-iron, like that repreſented in the 62d figure, may be uſed in a furnace of ſheet-iron; but when this is done, the fire-place muſt be caſt with a prejecting rim above, in order that it may be ſuſpended in its place. The ſand-rim may likewiſe be of caſt-iron, and it may be faſtened to the inverted hollow cone, *c*, *d*, *e*, *f*, by rivets.

The ſhort tube *p*, which ſerves to ſupport the tube which carries off the ſmoke, may alſo be made of caſt-iron, and it may be faſtened to the outſide of the furnace by three rivets. As it may be made of ſuch a form that its mould will deliver from the ſand, it will coſt leſs when made of caſt-iron than when made of ſheet-iron; and it will have another advantage: its form on the inſide will be more regular, and it will be better adapted on that account for receiving the end of the tube, which it is deſigned to receive. Its length need not exceed 1 inch or 1 ½ inches, and its internal diameter may be about 1 ½ inches at its projecting extremity, and ſomething leſs at its other end, where it joins the ſide of the furnace.

Of ſmall Portable Kitchen Furnaces conſtructed of Earthen-ware.

The following figure repreſents a furnace of this kind (of earthen-ware) deſtined for heating boilers of the ſame kind, and of the ſame dimenſion as thoſe proper to be uſed with the two (iron) furnaces laſt deſcribed:

Fig. 64.



This figure repreſents a vertical ſection of the furnace, drawn to a ſcale of four inches to the inch; and it gives an idea ſo clear and ſatisfactory of the form of this furnace, that a detailed deſcription of it would be ſuperfluous.

The fire-place is diſtinct from the body of the furnace, and its form and poſition are ſuch that it cannot crack and injure the body of the furnace by its expanſion with heat. It reſembles very much the caſt-iron fire-place juſt deſcribed, and the ſame principles regulated the contrivance of both of them. It ſhould be bound round with iron wire, in order to hold it together, in caſe it ſhould crack with the heat of the fire. Two places for the wire, one near its brim, and the other lower down, are ſhewn in the figure.

The aperture by which the air enters the aſh-pit is cloſed by a regiſter-ſtopper, repreſented in the figure, or a conical ſtopper of earthen-ware may be uſed for that purpoſe.

If ſuch earths are uſed in conſtructing theſe ſmall portable furnaces, as are known to ſtand fire well, there is no doubt but theſe furnaces may, with proper uſage, be made to laſt a great while ;— and for confining heat, they are certainly preferable to all others.

The portable kitchen furnaces in China, are all conſtructed of earthen-ware ; and no people ever carried thoſe inventions which are moſt generally uſeful in common life to higher perfection than the Chineſe. They, and they only, of all the nations of whom we have any authentic accounts, ſeem to have had a juſt idea of the infinite importancc of thoſe improvements which are calculated to promote the comforts of the loweſt claſſes of ſociety.

What immortal glory might any European nation obtain by following this wiſe example !

The Emperor of China, the greateſt monarch in the world, who rules over one full *third part* of the inhabitants of this globe, condeſcends *to hold* *the plough* himſelf one day in every year.—This he does, no doubt to ſhew to thoſe whoſe example never can fail to influence the great bulk of mankind, how important that art is by means of which food is provided.

Let thoſe reflect ſeriouſly on this illuſtrious example of provident and benevolent attention to the wants of mankind, who are diſpoſed to conſider the domeſtic arrangements of the labouring claſſes as a ſubject too low and vulgar for their notice.

If attention to the art by which food is provided be not beneath the dignity of a Great Monarch; that art by which food is prepared for uſe, and by which it may be greatly *economized*, cannot poſſibly be unworthy of the attention of thoſe who take pleaſure in promoting the happineſs of mankind.

As the implements uſed in China for cooking are uncommonly ſimple, it may perhaps be amuſing to the reader to be made acquainted with them. They conſiſt of the two articles repreſented below;

Fig. 65

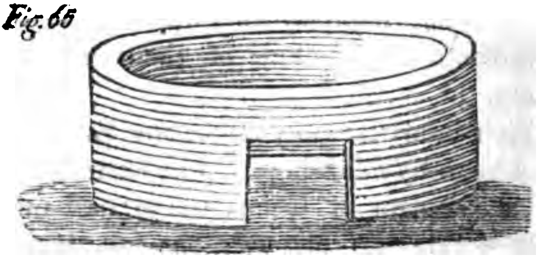
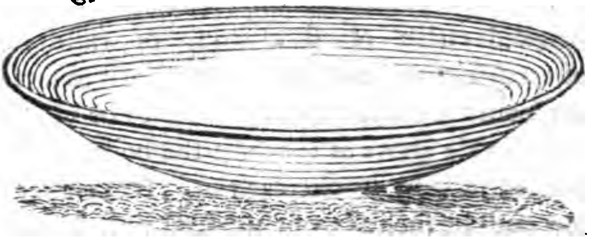


Fig. 66



This figure 65, which is made of earthen-ware, is the fire-place, which is ſet down on the ground. The ſhallow pan repreſented by the figure 66, is of caſt-iron, and ſerves for every proceſs of Chineſe cookery. It is caſt very thin, and if by any accident a hole is made in it, their itinerant tinkers mend it, by filling up the hole, which they do with ſo much dexterity that ſcarcely a mark is left behind.

When the dinner conſiſts of ſeveral diſhes they are all cooked in this pan, one after the other, and thoſe which are done firſt are kept warm till they are ſent to table.

I leave it to the ingenuity of Europeans to appreciate theſe ſpecimens of Chineſe induſtry.

But to return from this digreſſion, to our portable kitchen furnaces—Although theſe furnaces are peculiarly adapted for heating boilers and ſtewpans that are *armed*, yet boilers on the common conſtruction, or ſuch as are not ſuſpended in cylinders, may eaſily be uſed with them. When this is to be done, a detached hollow cylinder or cone muſt be uſed, in the manner deſcribed in the preceding chapter. and repreſented in the figure 50. This cylinder or cone (which may be conſtructed either of ſheet-iron, of caſt-iron, or of earthen-ware) muſt be about an inch higher than the boiler is deep, with which it is to be uſed; and juſt ſo wide above as to admit the boiler to be ſuſpended in it by its circular rim. Its diameter below muſt be ſuch as to fit the ſand rim, in which it muſt ſtand, when it is uſed,

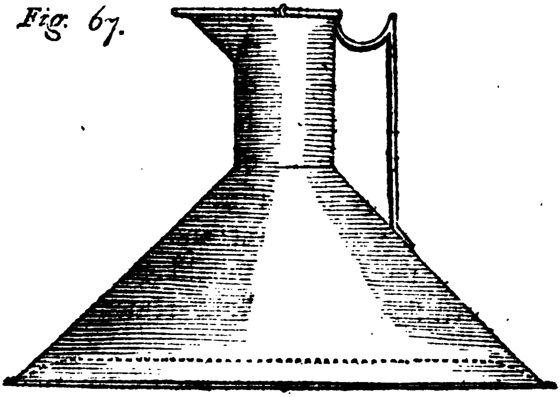
CHAP. XII.

Of the conſtruction of TEA-KETTLES, *proper to be uſed with Regiſter-Stoves, and portable Kitchen Furnaces.—Theſe utenſils may be conſtructed of tin, and ornamented by japanning and gilding.—When they are properly conſtructed and managed, they may be heated over a ſmall portable furnace in a very ſhort time, and with a ſurprizingly ſmall quantity of fuel.—Deſcriptions of four of theſe tea-kettles of different forms and ſizes.—Deſcription of ſeveral very* SIMPLE *and* CHEAP STEW-PANS *for portable Furnaces.—Deſcription of a* STEW-PAN *of* EARTHEN-WARE, *on an improved conſtruction.—This will probably turn out to be a moſt uſeful utenſil for cooking with portable furnaces.*

AS Tea-kettles are ſo much uſed in this country, and as they occaſion ſo great a conſumption of fuel (a large fire being frequently made in a grate, or kitchen-range, morning and evening, for the ſole purpoſe of heating a few pints of water to make tea) the ſaving of this unneceſſary trouble and expence is an object deſerving of attention. And in doing this it will be poſſible to improve very eſſentially the forms of tea-kettles in ſeveral reſpects, and at the ſame time to render their external appearance more neat and cleanly. If the forms I ſhall recommend ſhould not happen to pleaſe at firſt ſight, it ſhould be remembered that utility, cleanlineſs, and wholeſomeneſs are objects of more importance in caſes like that in queſtion than mere elegance of form—and after all, I am not ſure whether the forms I ſhall propoſe are not in reality quite as elegant as thoſe with which they will be compared. They will, no doubt, at firſt ſight appear uncouth to many perſons, but the eye will ſoon become accuſtomed to them; and their ſuperior cheapneſs, cleanlineſs, and uſefulneſs, will in the end procure them that preference which they deſerve. They may, no doubt, be conſtructed of the moſt elegant forms, on the principles I ſhall recommend, but I ſhall confine my deſcriptions to ſuch forms as are moſt ſimple, and of the eaſieſt and leaſt expenſive conſtruction, leaving it to thoſe to beautify the article whoſe buſineſs and intereſt it is to ſet off their goods to the beſt advantage.

The following figure repreſents a tea-kettle of the ſimpleſt form, ſuited to a regiſter kitchen ſtove, or to a portable furnace, ſuch as has juſt been deſcribed:

Fig. 67.



This tea-kettle is conſtructed of tin, and it may be japanned on the outſide to prevent its ruſting, and to give it an elegant and cleanly appearance. Its bottom, which is 11 inches in diameter, is not flat, but it is raiſed up about half an inch in the manner pointed out by a dotted line. The body of this tea-kettle is of a conical form, ending above in a cylinder, 3 inches in length and 2 inches in diameter. The ſpout, which reſembles that of a coffee-pot, is ſituated at the top of this cylinder, and it has a flat cover, faſtened by a hinge, which prevents duſt or ſoot from falling into it when it ſtands on the hearth. When this tea-kettle is put over the fire it ſhould not be filled higher than to the top of the cone, or lower end of the cylinder, otherwiſe it will be liable to boil over. The kettle, ſo filled, will contain 4 pints of water, and if it be heated over one of the ſmall portable furnaces deſcribed in the foregoing chapter, it may be made to boil in about 10 minutes, with 6¼ oz. of dry wood, which at the price at which wood is commonly ſold in London, would coſt ⅜ of a farthing.*

The tea-kettle repreſented by the following figure is rather more complicated, but ſtill its form is more ſimple, and more advantageous in ſeveral reſpects, than thoſe which are in common uſe, and it is well adapted for the fire-places we have recommended. It is drawn to a ſcale of 4 inches to the inch:

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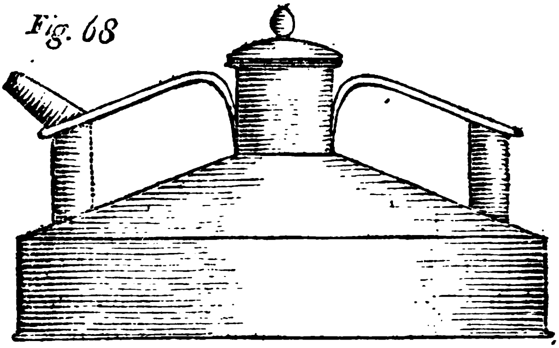
* One pint of water only being put into this tea-kettle, over a very ſmall wood fire, made in the portable furnace repreſented in the foregoing figure 63 (ſee page 293) it was heated and made to boil *in two minutes and an half.*

Fig. 68

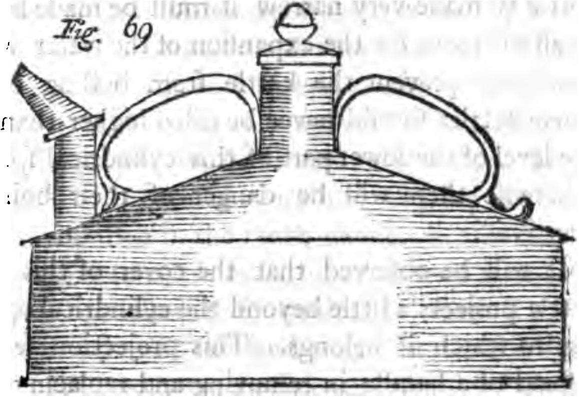


This kettle has two handles, each of which is ſupported on the outſide, or near the circumference of the kettle, by a ſmall vertical tube ¾ of an inch in diameter, and 1¾ inches in height. That on the left hand is open, and forms a part of the ſpout; but that on the right hand is cloſed at both ends. The bottom of this kettle, alſo the bottoms of thoſe repreſented in the two following figures, like that of the laſt (figure 67) is not flat, but is raiſed up about half an inch above the level of the lower part of the cylindrical ſides of the kettle.

This kettle holds about 3 quarts of water, which can be made to boil with the combuſtion of 9½ oz. of wood.

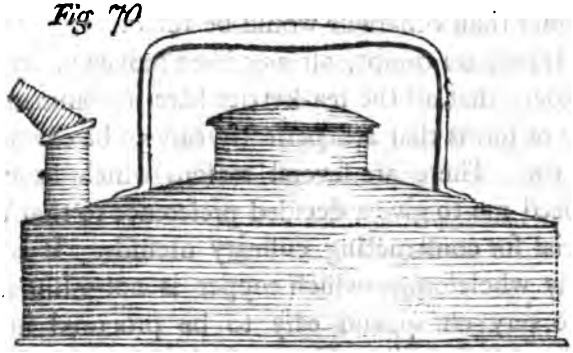
The following kettle holds about 1 gallon, and may be made to boil with ¾ lbs. of wood: which would coſt juſt ¾ of a farthing.

Fig. 69



The following kettle is not eſſentially different from thoſe two laſt deſcribed, except in the form of its handle. It holds about 3 quarts.

Fig. 70



The cylindrical opening of this kettle above, where the water is introduced, is conſiderably wider than thoſe in the two foregoing figures. It was made wider, becauſe it was neceſſary to make it lower, in order to make room for the hand without raiſing the handle too high. When this part of a tea-kettle is made very narrow it muſt be made high, to afford room for the expanſion of the water with heat, and prevent the kettle from boiling over. Theſe kettles ſhould never be filled higher than to the level of the lower part of this cylindrical ſpace, otherwiſe there will be danger of their boiling over*.

It will be obſerved that the cover of this tea-kettle projects a little beyond the cylindrical opening to which it belongs. This projection ſerves inſtead of a handle in removing and replacing the cover. The cover of a tea-kettle is uſually furniſhed with a knob for that purpoſe; but theſe knobs are in the way when the kettle is lifted up by its handle, unleſs the handle be made much higher than otherwiſe would be ſufficient.

It has, no doubt, already been remarked by the reader, that all the tea-kettles here recommended are of forms that are perfectly eaſy to be executed in tin. There are ſeveral reaſons which have induced me to give a decided preference to that material for conſtructing culinary utenſils. It is not only wholeſome—which copper is not—but it is alſo very cheap, and eaſy to be procured in all places, and it is eaſily worked: it is moreover light and ſtrong, and not liable to be injured by accidents; and if meaſures be taken to prevent the effects of ruſt, it is very durable.

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* I find by experiments made ſince the above was written, that tea-kettles of this kind ſhould never be filled above two-thirds full, otherwiſe they will be very apt to boil over.

The four tea-kettles repreſented in the four laſt figures are all particularly deſigned to be uſed with the portable furnaces deſcribed in the laſt chapter; and for that purpoſe they are well calculated, although they are not ſuſpended in cylinders. They may likewiſe be uſed with the regiſter kitchen ſtoves deſcribed in the tenth chapter of this Eſſay. As their bottoms are raiſed up, and as their diameters are ſuch that their conical or vertical ſides enter into, and fit the ſand-rims of thoſe furnaces and ſtoves, the heat is effectually confined under them, and their outſides not being expoſed either to flame or to ſmoke, may be japanned, and they may eaſily be kept ſo clean as to be fit to be placed upon a table, over a lamp, or upon a heater, placed in a ſhallow diſh of china or earthenware. They are even capable of being elegantly ornamented by gilding or painting, or both.

They are likewiſe well calculated for being heated by a lamp; and if an argand's lamp be uſed for that purpoſe, they may be made to boil in a ſhort time, and at a ſmall expence. Placed on a handſome tripod, on a table, with an elegant argand's lamp under it, one of theſe kettles, handſomely ornamented by japanning and gilding, would make no mean appearance, and would coſt much leſs than the commoneſt tea-urn that could be bought.

But it is not ſolely for making tea that theſe kettles will be found uſeful; they will anſwer perfectly well for boiling water for many other purpoſes; and if portable kitchen furnaces ſhould come into uſe, boiling hot water will often be wanted for filling ſauce-pans and ſtew-pans; and no utenſil can be better contrived for heating and boiling water over a portable kitchen furnace than theſe kettles.

In conſtructing them care ſhould be taken to fill all their ſeams well with ſolder, which, by covering the naked edges of the iron, will contribute more than any thing to the prevention of ruſt, and the durability of the article; and they ſhould likewiſe be well japanned on the outſide in every part except the bottom, which ſhould not be japanned.

The reaſon why I have not made theſe tin tea-kettles double, is this: tea-kettles are commonly uſed merely for *making water boil*, which, with the kettles here recommended, can be done *in a very ſhort time*, conſequently much heat cannot poſſibly be loſt during that proceſs, in conſequence of the top and ſides of the kettle being expoſed naked to the cold air of the atmoſphere. Were theſe utenſils deſigned for *keeping water boiling hot* a great length of time, the caſe would be very different, and then it might be well worth while to make them double, in order more effectually to confine the heat in them.

The *ſaving of time* in making them boil, by making them double, would be very trifling indeed, for till the water has become very hot, there is but little loſs of heat through the ſides and top of the kettle; the communication of heat being rapid in proportion as the temperature of the hot body is high, compared with that of the colder body into which the heat paſſes.

If a tea-kettle, filled with water at the temperature of the atmoſphere at the time, on being put over a fire, be brought to boil in 10 minutes, it will, during that time, have loſt only half as much heat as it will loſe in the next ten minutes, if it be kept boiling hot during that time.

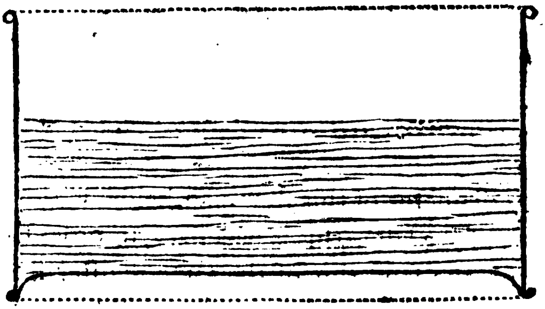
All theſe kettles are of ſuch forms as will render it very eaſy to cover them, ſhould it be thought adviſable to make them double; and by covering them with plated or gilt copper, they may be made very elegant at a ſmall expence.

Of the conſtruction of cheap Boilers and Stew-pans to be uſed with ſmall Portable Kitchen Furnaces.

The beſt boilers and ſtew-pans that can be uſed with theſe furnaces, are undoubtedly thoſe which were deſcribed in the 10th chapter of this Eſſay, but utenſils on a ſimpler conſtruction may be made to anſwer very well, and may perhaps be preferred by many on account of their cheapneſs.

The following figure repreſents a vertical ſection of a ſtew-pan on a much more ſimple conſtruction than any of thoſe already deſcribed:

Fig 71



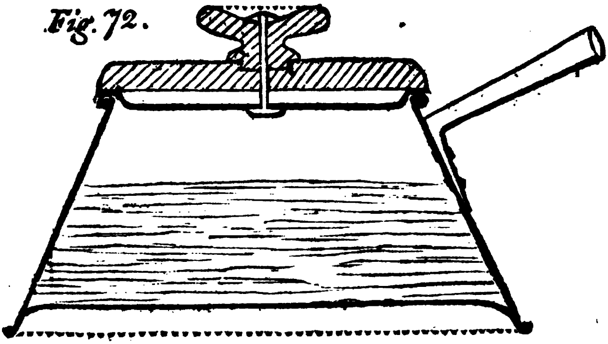
This

This ſtew-pan (which is drawn to a ſcale of four inches to the inch) being of a proper diameter below to fit the ſand-rim of the portable furnace, and its bottom being raiſed up about half an inch, in order to allow its vertical ſides to deſcend into that ſand-rim, it is plain that it may be uſed with the furnace, in the ſame manner as the tea-kettles juſt deſcribed are uſed with it. It may likewiſe be uſed with the regiſter-ſtoves deſcribed in the 10th chapter of this Eſſay.

In order that this ſtew-pan may the more eaſily be kept clean, the joinings of its bottom and ſides ſhould be well filled up on the inſide with ſolder.

The following figure repreſents another, and ſmaller ſtew-pan, conſtructed on the ſame principles with that juſt deſcribed, and deſigned for the ſame uſe:

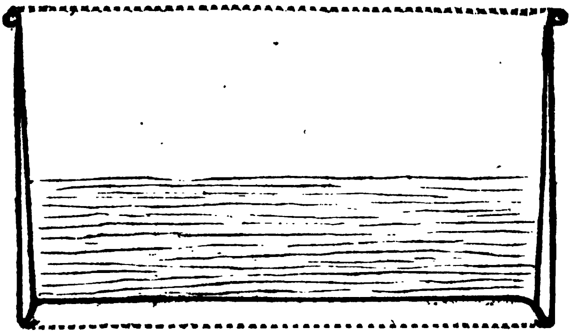
Fig. 72.



The diameter of this ſtew-pan below is the ſame as that of the laſt—this is neceſſary, in order that it may fit the ſand-rim of the ſame regiſter ſtove or portable furnace—but its diameter above is much leſs; and it is alſo leſs deep, conſequently its capacity is much ſmaller. The cover of this ſtew-pan is of wood lined with tin. It is in all reſpects like that repreſented by the figure 35 (ſee chapter VII. of this Eſſay, page 222). Both theſe ſtew-pans are ſuppoſed to be conſtructed of tin; but they might be made of tinned copper. The handle of the ſtew-pan repreſented by the figure 71, is omitted for want of room.

The following figure repreſents a vertical ſection of a double, or armed ſtew-pan, on a very ſimple conſtruction:

Fig. 73.

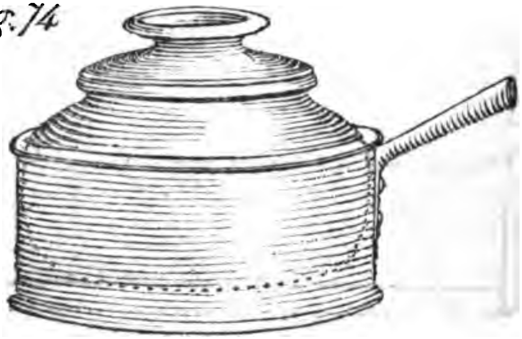


The ſtew-pan, (which is drawn to a ſcale of four inches to the inch) is ſuppoſed to be made of tin, and it is ſuppoſed to be turned over a wire at its brim. The cylinder by which it is ſurrounded is of ſheet-iron, and the ſtew-pan and the cylinder are faſtened together by, the former being driven into the latter, with ſome degree of force, and ſticking in it above, where they come into cloſe contact. The lower edge of the cylinder being turned inwards forms a narrow rim, on which the lower end of the ſtew-pan reſts.

Of the conſtruction of Stew-pans of EARTHEN-WARE *and* PORCELAIN, *to be uſed with Regiſter Stoves and Portable Kitchen Furnaces.*

The following figure ſhews how, by means of a hoop, or cylinder of ſheet-iron, a ſtew-pan, or ſauce-pan, of earthen-ware, or of porcelain, of a ſuitable form and ſize, may be fitted to be uſed with a regiſter kitchen ſtove, or portable furnace.

Fig. 74



This figure is drawn to a ſcale of ſix inches to the inch. The form of the lower part of the ſtew-pan is pointed out by a dotted line. The top and the bottom of the cylinder of ſheet-iron are both turned over circular iron wires. The handle of this ſtew-pan is of iron, and it is fixed to the cylinder by rivets. The ſtew-pan is firmly faſtened to its metallic hoop or cylinder, firſt, by making this cylinder of a proper ſize to fit it; and ſecondly, by wedging it both above and below with very thin wedges, made of narrow pieces of ſheet-iron, and by filling up the vacuities, above and below, with good cement.

The cover of this ſtew-pan, which is of earthen-ware (or porcelain) is made of a peculiar form. It has a kind of foot inſtead of a handle, which ſerves for ſupporting it when it is taken off from the ſtew-pan, and laid down in an inverted poſition. By means of this ſimple contrivance it is rendered leſs liable to be dirtied on the inſide, and of communicating dirt to the victuals.

If an earthen ſtew-pan, of the form repreſented in this figure, be made of good materials, that is to ſay, of a proper mixture of the different earths, well worked, and if its bottom be made thin, and of equal thickneſs in every part of it that is expoſed to the fire, there is little doubt, I think, of its ſtanding the heat of a regiſter ſtove, or of a ſmall portable kitchen furnace; and if this ſhould be the caſe, I ſhould certainly never think of recommending any other kitchen utenſils in preference to theſe.

It appears to me to be very probable that unglazed Wedgewood's ware would be as good a material as could be found for theſe ſtew-pans. The intelligent gentleman who directs Mr. Wedgewood's wood's manufactory, cauſed ſeveral of them to be made, after drawings which I gave him, and thoſe I found, upon trial, to anſwer very well.

If it ſhould be found that kitchen utenſils, conſtructed and fitted up, or mounted, on the principles here pointed out, ſhould anſwer as well as there is reaſon to expect; as nothing would be eaſier than to make earthen boilers with *ſteam-rims*, and to form *ſteam-diſhes* of earthen-ware to fit them; every utenſil for cooking, by *boiling* and *ſtewing*, might be conſtructed of that moſt cleanly, moſt elegant, and moſt wholeſome material—*earthen-ware.*

I heſitated a long time before I reſolved to publiſh this laſt obſervation;—for however anxious I am to promote uſeful improvements, and eſpecially ſuch as tend to the preſervation of health, and the increaſe of rational enjoyments, it always gives me pain when I recollect how impoſſible it is to introduce any thing new, however uſeful it may be to ſociety at large, without occaſioning a temporary loſs or inconvenience to ſome certain individuals, whoſe intereſt it is to preſerve the ſtate of things *actually exiſting.*

It certainly requires ſome courage, and perhaps no ſmall ſhare of enthuſiaſm, to ſtand forth the voluntary champion of the public good:—but this is a melancholy reflection, on which I never ſuffer my mind to dwell. There is no ſaying what the conſequences might be were we always to ſet down before we engage in a laudable undertaking, and meditate profoundly upon all the dangers and difficulties that are inſeparably connected with it, The moſt ardent zeal might perhaps be damped, and the warmeſt benevolence diſcouraged.

But the enterprizing ſeldom regard dangers, and are never diſmayed by them; and they conſider difficulties but to ſee how they are to be overcome. To them *activity* alone is life—and their glorious reward, the conſciouſneſs of having done well. *Their* ſleep is ſweet when the labours of the day are over; and they await, with placid compoſure, that reſt, which is to put a final end, to all their labours, and to all their ſufferings.

CHAP. XIII.

Of cheap Kitchen Utenſils for the uſe of the Poor.—The condition of the lower claſſes of Society cannot be improved without the friendly aſſiſtance of the Rich.—They muſt be TAUGHT *economy, and they cannot be inſtructed by books, for they have not leiſure to read.—Advice intended for their good muſt be addreſſed to their benevolent and more wealthy neighbours.—An account of the Kitchen Utenſils of the poor itinerant Families that trade between Bavaria and the Tyrol.—Theſe utenſils were adopted by the Bavarian Soldiers.—An account of ſome attempts that were made to improve them.—Deſcription of a very ſimple cloſed Fire-Place conſtructed with ſeven looſe Bricks—How this Fire-Place may be improved by uſing three Bricks more, and a few Pebbles.—Deſcription of a very uſeful* PORTABLE KITCHEN BOILER, *of caſt-iron, ſuitable for a ſmall family.—An account of a very ſimple method of* COOKING WITH STEAM, *on the cover of this Boiler.—Deſcription of a* STEAM-DISH *of earthenware, or of caſt-iron, to be uſed with this Boiler.—Deſcription of a Boiler ſtill more ſimple in its conſtruction, proper to be uſed with a ſmall Portable Kitchen Furnace.—The cooking Apparatus here recommended for the uſe of the Poor, may, with a ſmall addition, be rendered ſerviceable for warming their dwellings in cold weather.*

AMONGST the great variety of enjoyments which riches put within the reach of perſons of fortune and education, there is none more delightful than that which reſults from doing good to thoſe from whom no return can be expected; or none but gratitude, reſpect, and attachment. What exquiſite pleaſure then muſt it afford, to collect the ſcattered rays of uſeful ſcience, and direct them, *united*, to objects of general utility!—to throw them in a broad beam on the cold and dreary habitations of the poor! ſpreading cheerfulneſs and comfort all around!

Is it not poſſible to draw off the attention of the rich from trifling and unprofitable amuſements, and engage them in purſuits in which their own happineſs and reputation, and the public proſperity, are ſo intimately connected? What a wonderful change in the ſtate of ſociety might, in a ſhort time, be effected by their *united efforts!*

It is hardly poſſible for the condition of the lower claſſes of ſociety to be eſſentially improved without that kind and friendly aſſiſtance which none can afford them but the rich and the benevolent. They muſt be *taught*, and who is there, in whom they have confidence, that will take the trouble to inſtruct them? They cannot learn from books, for they have not time to read: and if they had, how few of them would be able, from a written deſcription, to comprehend what they ought to know! If I write for their inſtruction, it is to the rich that I muſt addreſs myſelf; and if I am not able to engage *them* to aſſiſt me, all my labours will be in vain. But to proceed:

In contriving kitchen utenſils for cottagers, two objects muſt frequently be had in view; viz. the cooking of victuals, and the warming of the habitation; and as theſe objects require very different mechanical arrangements, ſome addreſs will be neceſſary in combining them.

Another point to which the utmoſt attention muſt be paid, is to avoid all complicated and expenſive machinery. Inſtruments for general uſe ſhould be as ſimple as poſſible; and ſuch as are deſtined for the uſe of thoſe who muſt earn their daily bread by their labour, ſhould be cheap, durable, and not liable to accidents, or to be often in want of repairs.

As food is more indiſpenſably neceſſary than a warm room; and as the moſt common proceſs of cookery is boiling, I ſhall firſt ſhow how that proceſs may be performed in the moſt economical manner poſſible; and ſhall then point out the means that may be uſed for rendering the kitchen-fire uſeful in warming the room in which cookery is carried on.

One of the cheapeſt utenſils for cooking, for a family, that ever was contrived, is, I verily believe, that uſed by the itinerant poor families that trade between Bavaria and the Tyrol, bringing raiſins, lemons, &c. from the ſouth ſide of the mountains (which they tranſport in light carts drawn by themſelves) and carrying back earthenware.

As theſe poor people have no fixed abode, and never ſtop at an inn, or other public-houſe, but, like the gipſies in this country, ſleep in empty barns, and under the hedges by the road ſide, they carry with them in their cart all that they poſſeſs; and among the reſt the whole of their kitchen furniture, which conſiſts of *one ſingle article*—a deep frying-pan of hammered iron, with a ſhort iron handle.

In this they bake their cakes—boil their brown ſoup—make their haſty pudding—ſtew their greens; —fry their meat—and in ſhort perform every proceſs of their cookery; and when their victuals are done, their boiler ſerves them for a diſh, which, being placed on the ground, the family ſit round it; each individual, capable of feeding himſelf, being provided with a wooden ſpoon.

This is precifely the ſame kind of kitchen utenſil as that uſed by the Bavarian wood-cutters, when they go into the mountains to fell wood; (ſee Eſſay III. page 295, vol. 1.) and it is likewiſe uſed by many poor families in the Tyrol and in Bavaria.

Theſe broad ſtew-pans—with the addition of a tripod of hammered iron—were adopted, many years ago, in Bavaria, for the uſe of the ſoldiers in barracks; and they ſtill continue to be uſed by them: ſome ſucceſsful attempts to improve them, have, however, lately been made, and it was the experiments which led to thoſe improvements, that firſt induced me to turn my attention to this uſeful article of kitchen furniture.

Before I proceed any farther in my account of theſe ſhallow pans, and of the improvements of which they have been found to be capable, it may perhaps be proper to give an account of the manner in which they are conſtructed, and of the price at which they are ſold.

All thoſe which are uſed in Bavaria come from the Tyrol, or from Styria, where there are conſiderable manufactories of them; and they are ſold at Munich, by wholeſale, at 22 creutzers (about 7 ½d. ſterling) the pound, Bavarian weight, which is at the rate of 6 d. ſterling per lb. avoirdupois weight.

One of theſe pans of large dimenſions, namely, 18 inches in diameter above, or at its brim, 15 inches in diameter below, and 4 inches deep, bought at an ironmonger's ſhop at Munich, coſt me three ſhillings ſterling.

In manufacturing theſe pans, five of them, one placed within the other, are brought under the hammer at the ſame time; and, in being hammered out, and brought to their proper form and thickneſs, they are frequently heated red hot. When they come from the hammer they are carried to the lathe, and are turned on the inſide, and made clean and bright, and their edges are turned and made even. They are then packed up, one within the other, or, in neſts (as theſe parcels are called) and are ſold by weight.

The following figure repreſents one of theſe pans in its moſt ſimple ſtate, placed on three ſtones, over a fire made with ſmall ſticks of wood, on the ground, in the open air.

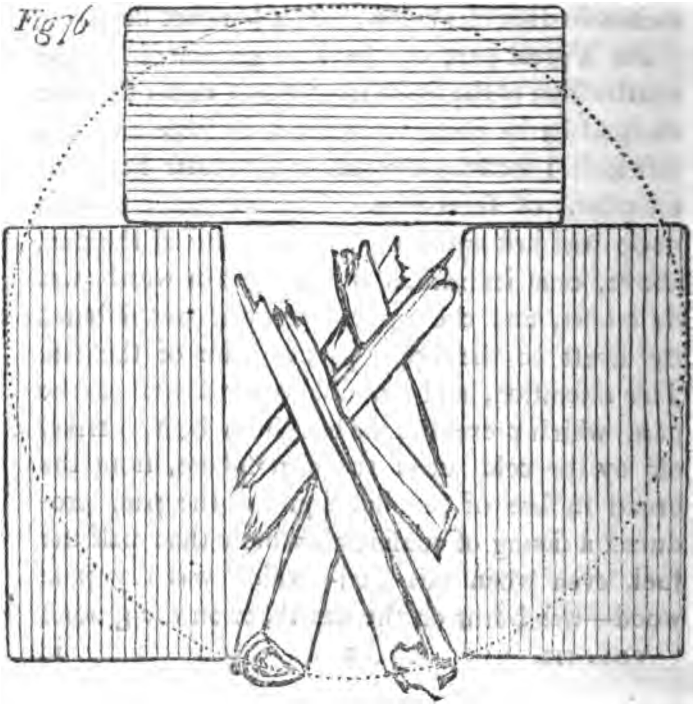
Fig: 75.

The pan uſed by the Bavarian ſoldiers, which, as I juſt obſerved, is placed on a tripod, or trivet, of iron, is about 20 inches in diameter above, 16 inches in diameter below, and 4½ inches deep.

As a great part of the heat generated in the combuſtion of the fuel that is burnt under this pan eſcaped by its ſides, to prevent, in ſome meaſure, this loſs, I incloſed the pan in a circular hoop, or cylinder, of ſheet-iron. The diameter of this hoop was juſt equal to the diameter of the pan, above, or at its brim, and its height or width, was ſix inches, and the upper part of it was faſtened by rivets to the upper part or brim of the pan. This alteration, and a double cover fitted to the pan, which prevented the heat from being carried off by the cold air of the atmoſphere, from the broad ſurface of the hot liquid in the pan, produced a ſaving of conſiderably more than half the fuel, even when this fuel—which was dry pine wood—was burnt on the hearth, or on the ground in the open air, and no means were uſed for confining the heat on either ſide. But the ſaving was ſtill greater when the fire was made in a cloſed fire-place.

For a pan of this kind of 14 or 15 inches in diameter at its brim, a very good temporary fire-place may be conſtructed in a moment, and almoſt without either trouble or expence, merely with ſeven common bricks: Six of them, laid down upon the hearth, in pairs, one upon the other, in the manner repreſented in the following figure, form the fire-place; and the ſeventh, placed edge-wiſe, ſerves as a ſliding door, to cloſe this fire-place in front, more or leſs, as ſhall be found beſt.

Fig 76



This little fire-place, which is better calculated for wood, or for turf, than for coals, is repreſented filled with fire-wood ready to be kindled, and a dotted circular line ſhews where the bottom of the circular hoop of ſheet-iron (in which the pan is ſuſpended) ſhould be ſet down upon the top of the three bricks which are uppermoſt.

If, in conſtructing this fire-place, its walls be made higher, by uſing nine bricks, inſtead of ſix, (laid down flat upon one another, by threes) and if a few looſe pebbles, or ſtones of any kind, about as large as hen's-eggs, be put into it, under the fuel, theſe additions will improve it conſiderably. The fuel being laid upon theſe pebbles, inſtead of lying on the hearth, or on the ground, the air neceſſary for its combuſtion will the more readily get under it; which will cauſe the fire to burn brighter, and more heat to be generated.

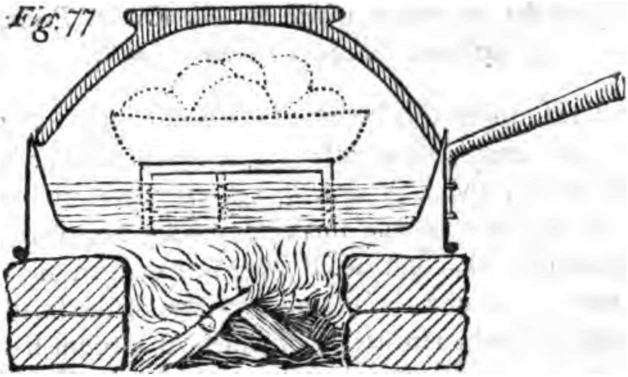
Theſe ſmall ſtones will likewiſe ſerve other uſeful purpoſes. They will grow very hot, and when they are ſo they will increaſe the violence of the combuſtion, and the intenſity of the heat; and even after the fuel is all conſumed, they will ſtill be of uſe, by giving off gradually to the pan, the heat which they will have imbibed.

Savages, who have few implements of cookery, make great uſe of heated ſtones in preparing their food; and civilized nations would do wiſely to avail themſelves, oftener than they do, of *their* ingenious contrivances.

I have already mentioned, that a conſiderable ſaving of fuel was made in conſequence of furniſhing the broad and ſhallow boilers of the Bavarian ſoldiers with double covers; but for boilers of this kind, that are deſtined for poor families, I would recommend wooden or earthen diſhes, turned upſide down, inſtead of theſe double covers; which diſhes may alſo be uſed for ſerving up the victuals after it is cooked. By this contrivance an article neceſſary in houſe-keeping will be made to ſerve two purpoſes; and beſides this advantage, as a deep bowl, or platter, turned upſide down, over the ſhallow boiler, will leave a conſiderable ſpace above the level of the boiler, which, as ſteam is lighter than air, will always be filled with hot ſteam, when the water in the ſhallow pan is boiling, notwithſtanding that the joinings of this inverted diſh with the rim of the pan will not be ſteam-tight, a piece of meat much larger than could be covered by the water in this ſhallow pan might be cooked in it, or potatoes or greens, placed above the ſurface of the water in the pan, might be cooked in ſteam.

The following figure, which repreſents a vertical ſection of one of theſe ſhallow iron boilers, 14 inches in diameter above, ſurrounded by a cylindrical hoop of ſheet iron, for confining the heat, and covered by an inverted earthen diſh, will give a clear idea of the propoſed arrangement.

Fig. 77



The fire-place repreſented in this figure, is that ſhewn in the preceding figure (76) and is conſtructed of ſix looſe bricks. The brick which occaſionally ſerves to cloſe the opening into the fire-place in front, is not ſhewn.

A ſhallow diſh is repreſented (by dotted lines) ſtanding on a ſmall tripod above the ſurface of the water in the boiler, and filled with potatoes, which are ſuppoſed to be boiled in ſteam.

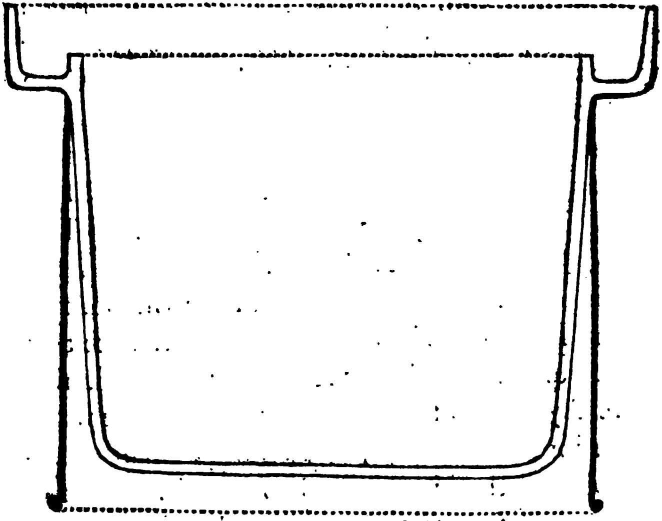
The earthen diſh, which covers the boiler, is repreſented with a ſmall projection, like the foot which is frequently given to earthen diſhes: This projection ſerves inſtead of a handle, when the diſh is placed upon, or removed from the boiler.

This I believe to be the cheapeſt contrivance that can be uſed for cooking victuals for a poor family, eſpecially when the durability of the utenſil is taken into the account, and alſo the ſmall quantity of fuel that is required to heat it. The following contrivance will however be found more convenient, and not much more expenſive:

Deſcription of a very uſeful portable Kitchen Boiler, of caſt-iron, ſuitable for a ſmall family.

The form of this boiler is ſuch that it may eaſily be caſt, and conſequently it may be afforded at a low price; and it is equally well calculated to be uſed with one of the ſmall temporary fire-places juſt deſcribed, conſtructed with ſix, or with nine looſe bricks, or to be heated over one of the ſmall portable kitchen furnaces, of which an account has been given in Chap. XI. It may be made of any dimenſions, but the ſize I would recommend for a ſmall poor family is that indicated by the following figure, which is drawn to a ſcale of four inches to the inch.

Fig. 78

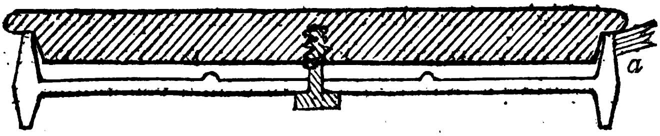


This boiler is 10 ½ inches in diameter above, on the inſide of the ſteam rim; 9 ½ inches in diameter below, and 8 ½ deep, meaſured from the top of the inſide of the ſteam rim; conſequently it will hold about 3 gallons. Its greateſt diameter at its brim is 13 ½ inches, and total height to the top of its ſteam rim is 9 ¼ inches.

The hollow cylinder of ſheet-iron in which this boiler is ſuſpended, and which confines the heat by defending its ſides from the cold air of the atmoſphere, is 8 ¾ inches high, and juſt 11 inches in diameter.

When this boiler is uſed for preparing only one diſh of victuals, or for cooking ſeveral things that may, without inconvenience, be all boiled together in the ſame water, it may be covered with the cover repreſented in the following figure.

Fig. 79.



This cover is compoſed of one piece of caſt-iron, covered above with a flat circular piece of wood, which ſerves for confining the heat. The wood is faſtened to the iron by means of a ſtrong wood ſcrew, with a flat ſquare head, which paſſes through a hole in the centre of the piece of caſt-iron.

The handle of this cover muſt project on one ſide, and muſt be faſtened to the metal and not to the wood. A piece of it is ſeen, (at *a.*) in the figure. It may either be caſt with the cover, or it may be of wrought iron, and faſtened to it by rivets.

The figure, which is a vertical ſection of the cover, ſhews the form of it diſtinctly, and it will be perceived that the piece of caſt-iron is of a ſhape which renders it eaſy to be moulded and caſt. The two ſmall projections on the right and left of the hole in the center of the cover are ſections of a circular projection, about $\frac{2}{10}$ of an inch in height, which, as will be ſeen preſently, is deſigned to ſerve a particular purpoſe. In the circumference of this horizontal projecting ring there are three equi-diſtant projecting blunt points, each about $\frac{3}{10}$ of an inch high above the level of the upper flat ſurface of the cover, or about $\frac{1}{10}$ of an inch higher than the ring from the upper part of which they project. Theſe three points ſerve for ſupporting a ſhallow diſh, in which vegetables or any other kind of victuals is put in order to its being cooked in ſteam.

Of the manner of uſing this ſimple apparatus for cooking with Steam.

This may eaſily be done in the following manner: The flat circular piece of wood belonging to the cover of this boiler, being removed, and the (caſt-iron) cover being put down upon the boiler, a ſhallow diſh, about 2 inches leſs in diameter than the cover, at its brim, or upper projecting rim, containing the victuals to be cooked in ſteam, is to be ſet down upon the cover, juſt in the centre of it, and an inverted earthen pot, or any other veſſel of a form and ſize proper for that uſe, being put over it, the ſteam from the boiler paſſing up through the hole in the centre of the cover, will find its way under the ſhallow diſh, and paſſing upwards by the ſides of this diſh, will enter the inverted earthen-pot, and, expelling the air, will take its place, and the victuals in the diſh will be ſurrounded on every ſide by hot ſteam.

Inſtead of an earthen-pot, an inverted glaſs-bell may be uſed for covering the victuals in the ſhallow diſh, which will not only render the experiment more ſtriking, and more amuſing, but will alſo, in ſome reſpects, be more convenient; for as the proceſs that is going on may be ſeen diſtinctly through the glaſs, a judgment may, in many caſes, be formed, from the *appearance* of the victuals, when they are ſufficiently done, without removing this veſſel, by which the ſteam is confined.

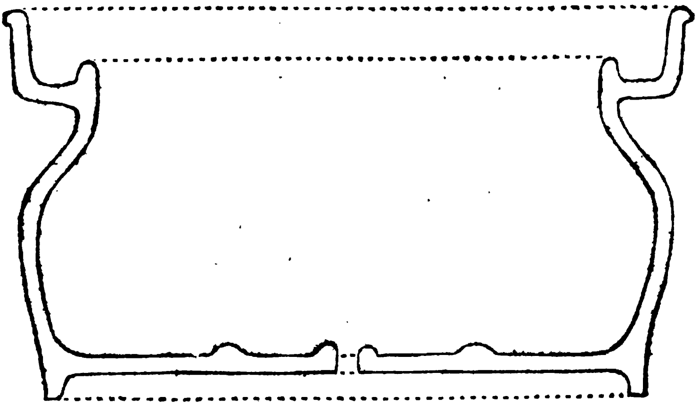
I would not, however, recommend glaſs veſſels for common uſe, as they would be too expenſive for poor families, and too liable to be broken. For *them*, a pot, of the commoneſt earthen-ware, or a ſmall wooden-tub, would be much more proper.

But for thoſe who can afford the expence, and who find amuſement in experiments of this kind, the glaſs-bell will be preferable to an opaque veſſel.

The manner in which this ſimple apparatus for cooking with ſteam is to be arranged, will be ſo eaſily underſtood from what has been ſaid, that a figure can hardly be neceſſary to form a clear and ſatisfactory idea of it. I ſhall therefore now proceed to a deſcription of another method of cooking with ſteam with theſe ſmall portable kitchen boilers.

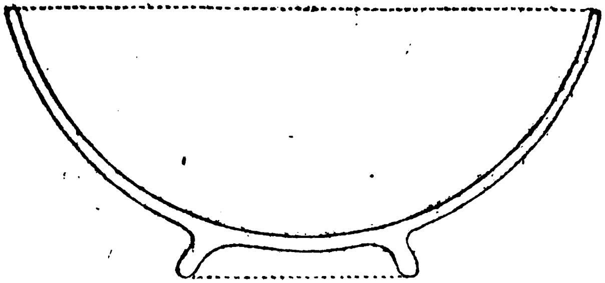
The following figure, which is drawn to a ſcale of four inches to the inch, repreſents a vertical ſection of a ſteam-diſh of earthenware, proper to be uſed with the boiler repreſented by the figure 78:

Fig. 80



The following figure repreſents a vertical ſection of an earthen bowl, which, being inverted, may be uſed occaſionally as a cover for the ſteam-diſh repreſented above, or as a cover for the boiler:

Fig. 81



When this diſh is not in uſe as a cover for the ſteam-diſh or the boiler, it may be made uſe of for other purpoſes. It may, for inſtance, ſerve for bringing the ſoup, or any other kind of food, upon the table, or for containing any thing that is to be put away. In ſhort, it may be employed for any purpoſe for which any other earthen bowl of the ſame form and dimenſions would be uſeful.

In like manner the ſteam-diſh may be made uſe of for many other purpoſes beſides cooking with ſteam.

This ſteam-diſh, and the bowl which ſerves as a cover to it, may both be made of caſt-iron; but when this is done, they ſhould be tinned on the inſide, and japanned on the outſide, to give them a neat and cleanly appearance, and prevent their ruſting. They may likewiſe be made of pewter; or by changing their forms a little they may be made of tin. The choice of the material to be employed in conſtructing them muſt, in each caſe, be determined by circumſtances.

The inverted bowl which covers the ſteam-diſh may be uſed likewiſe for covering the boiler, when the ſteam-diſh is not in uſe :—or, the coverof the boiler which is repreſented by the figure 79, may be made uſe of, inſtead of the inverted bowl, for covering the ſteam-diſh, and the bowl may be omitted altogether. One principal reaſon why I propoſed this bowl was, to ſhow how, by a little contrivance, an article uſeful in houſekeeping might, without any inconvenience or impropriety, be made to ſerve different purpoſes.

It is the intereſt of ſo many perſons to *increaſe* as much as poſſible the number of articles uſed in houſekeeping, and to render them as expenſive as poſſible, that I could not help feeling a ſtrong deſire to counteract this tendency in ſome meaſure, at leaſt in as far as it affects the comforts and enjoyments of the poor.

The natural, and the fair object of the exertions of the induſtrious part of mankind, being the acquirement of wealth, *their* ingenuity is employed and exhauſted in ſupplying the wants, and gratifying the taſte of the rich and luxurious.

It is not *their* intereſt to encourage the practice of economy, except it be *privately*, in their own families.

Though I ſometimes ſpeak with indignation of ſome of thoſe ridiculous forms, under which unmeaning and oſtentatious diſſipation too often inſults common decency, and mortally offends every principle of good taſte and elegant refinement, I am very, very far, from wiſhing to diminiſh the expences of the rich.

I well know that the free circulation of the blood is not more eſſentially neceſſary to the health of a ſtrong athletic man, than the free and *rapid* circulation of money is neceſſary to the proſperity of a great manufacturing and commercial country, whoſe power at home and abroad is neceſſarily maintained at a great expence.

Thoſe who would take the trouble to meditate profoundly on the influence which taxes and luxury neceſſarily have, and ever muſt have, in promoting that circulation, would, I am confident, become more reconciled to the preſent ſtate of things, and leſs alarmed at the progreſſive increaſe of public and private expence.

It is apathy, and a general *corruption of taſte* (which is inſeparably connected with avarice and *a corruption of morals*)—and not the progreſs of elegant refinement, that is a ſymptom of national decline.

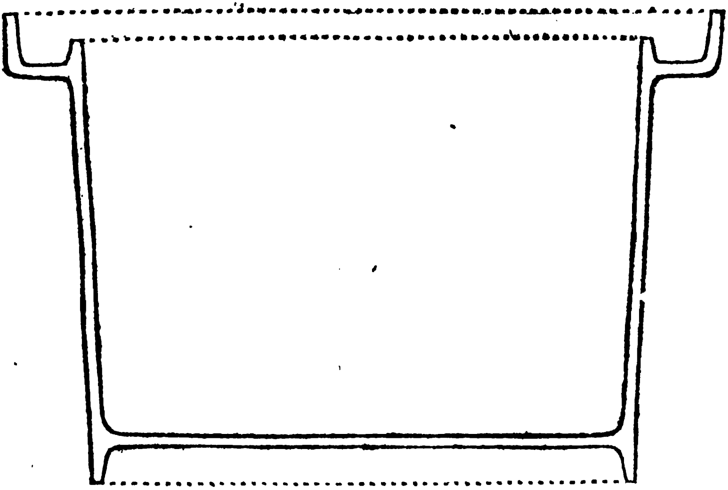
But to return to my ſubject.—The boiler above recommended (ſee figure 78) is peculiarly well adapted for being uſed with the ſmall portable furnaces deſcribed in the *eleventh* chapter of this eſſay; and as theſe furnaces will not be expenſive, I would ſtrongly recommend them for the uſe of poor families, to be uſed with the utenſils I have juſt been deſcribing.

A caſt-iron portable furnace, with one of theſe boilers, and one of the cheap tea-kettles deſcribed in the laſt chapter, which might all be purchaſed for a ſmall ſum, would be a moſt valuable acquiſition to a poor family. It would not only ſave them a great deal in fuel, and in time employed in watching and keeping up the fire in cooking their victuals, but it would alſo have a powerful tendency to facilitate and expedite the introduction of eſſential improvements in their cookery—which is an object of much greater importance than is generally imagined.

The boiler in queſtion (repreſented in the figure 78) is made double, or rather it is ſuſpended in an hollow cylinder of ſheet-iron. This hollow cylinder is certainly uſeful, as it ſerves to confine the heat about the boiler; but as it renders the implement more expenſive, and may wear out, or be deſtroyed by ruſt, after a certain time, I ſhall now ſhew how a boiler, proper to be uſed with one of the portable furnaces before recommended, may be ſo conſtructed as to anſwer without an hollow cylinder.

The following figure repreſents a vertical ſection of ſuch a boiler, of caſt-iron, drawn to a ſcale of four inches to the inch:

Fig. 82.



The eſſential difference between this boiler and that laſt deſcribed, conſiſts in a rim of about ¼ of an inch in depth, which deſcends below its bottom, and forms a kind of foot, on which it ſtands. This foot being made of ſuch diameter as to fit the ſand-rim of the furnace, into which it enters when the boiler is placed over the furnace, the flame and ſmoke of the fire are confined under the bottom of the boiler, quite as effectually as if the boiler were ſuſpended in a cylinder.

It can hardly be neceſſary that I ſhould obſerve here—what would probably occur to the reader without my mentioning it—that ſtew-pans and ſauce-pans for regiſter-ſtoves, and for portable furnaces of all kinds, with ſteam-rims, might be conſtructed on this ſimple principle.

It is on this principle that the tea-kettles are conſtructed that were recommended in the laſt chapter.

I ſhall finiſh this chapter by a few obſervations reſpecting the means that may be uſed for combining the method of cooking here recommended for poor families, with the warming of their habitations in cold weather. This can moſt readily be done by uſing an inverted, tall, hollow, cylindrical veſſel, of tin, thin ſheet-iron, or ſheet-copper, as a cover to the boiler (or to the ſteam-diſh, when that is uſed).

This will change the whole apparatus into a ſteam-ſtove, which, as I have elſewhere ſhewn, is one of the beſt kinds of ſtoves that can be uſed for warming a room.

Whenever this is done, care muſt be taken to ſtop up the chimney fire-place with a chimney-board, otherwiſe all the air warmed by the ſtove, and rendered lighter than the external air, will find its way up the chimney, and eſcape out of the room. A ſmall opening muſt, however, be left for the tube which carries off the ſmoke from the portable furnace into the chimney.

But whenever it is intended that a portable kitchen furnace ſhould be uſed occaſionally for warming a room by means of ſteam, it will be very adviſeable to conſtruct the furnace with an opening on one ſide of it, for the purpoſe of introducing the fuel, without removing the boiler.

But even ſhould no uſe whatever be made of this cooking apparatus in warming the room, the uſe of it will neverthelefs be found to be very economical. The quantity of fuel conſumed in preparing food will be greatly diminiſhed; and as a fire may at any time be lighted in one of theſe portable furnaces, almoſt in an inſtant, there will be no longer any neceſſity, nor any excuſe, for conſtantly keeping up a fire on the hearth in warm weather, which is but too often done in this country, even in places where fuel is neither cheap nor plenty. And even in winter, when a fire in the grate is neceſſary to render the room warm and comfortable, it will ſtill be good economy to light a ſmall ſeparate fire in a portable furnace, or other cloſed fire-place, for the purpoſe of cooking; for nothing is ſo ill-judged as moſt of thoſe attempts that are ſo frequently made by ignorant projectors *to force the ſame fire to perform different ſervices at the ſame time.*

The *heat* generated in the combuſtion of fuel is a *given quantity*, and the more *directly* it is applied to the object on which it is employed, ſo much the better, for the leſs of it will eſcape, or be loſt on the way; and what is taken away on one ſide for a particular purpoſe, can produce no effect whatever on the other—where it is not.

CHAP. XIV.

Miſcellaneous obſervations reſpecting Culinary Utenſils of various kinds, &c.—Of cheap Boilers of Tin, and of Caſt-iron, ſuitable to be uſed with Portable Furnaces.—Of earthen Boilers and Stew-pans proper for the ſame uſe.—Of LARGE PORTABLE KITCHEN FURNACES, *with fire-place doors.—Deſcription of a very cheap* SQUARE BOILER *of ſheet-iron, ſuitable for a* PUBLIC KITCHEN.—*Of* PORTABLE BOILERS *and Fire-places that would be very uſeful for preparing food for the poor in times of ſcarcity. Of the* ECONOMY *of* HOUSE-ROOM *in the arrangement of a Kitchen for a large family.—A ſhort account of the* COTTAGE GRATE, *and of a ſmall* GRIDIRON GRATE *for open chimney fire-places.—A deſcription of a* DOUBLE DOOR *for cloſed fire-places.*

ALTHOUGH my Eſſays are profeſſedly *experimental*, and I ſeldom or never preſume to trouble the Public with mere ſpeculations, or to recommend any mechanical contrivance till I have been convinced of its utility *by actual experiment*, yet my inquiries have been ſo numerous, and ſo varied, that I am frequently apprehenſive of embarraſſing my reader, and perhaps tiring and diſguſting him by too great a variety of detail. To avoid that evil (which would be fatal to all my hopes) I ſhall, in this chapter, paſs as rapidly as poſſible over a great number of different objects, many of which will, no doubt, be conſidered as curious and important. And to relieve the attention of the reader, and alſo to make it eaſy for him to paſs over what he may have no curioſity to examine, I ſhall divide my ſubject as much as poſſible, and ſhall treat each diſtinct branch of it under a ſeparate head of inquiry.

I ſhall likewiſe make a liberal uſe of figures, for by means of them it is often poſſible to convey more ſatisfactory information at a ſingle glance, than could be obtained by reading many ſentences. Whenever I ſet down to write, I feel my mind deeply impreſſed with a ſenſe of the reſpect which I owe, as an individual, to the Public, to whom I preſume to addreſs myſelf; and often conſider how blameable it would be in me, eſpecially when I am endeavouring to recommend economy, to trifle with the time of thouſands.

Too much pains cannot be taken by thoſe who write books, to render their ideas clear, and their language conciſe, and eaſy to be underſtood.

Hours ſpent by an author in ſaving *minutes*, or even *ſeconds*, to his readers, is time well employed. —But I muſt haſten to get forward.

Of the conſtruction of cheap Boilers and Stew-pans, of tin or caſt-iron, proper to be uſed with ſmall Portable Furnaces.

Theſe utenſils, when they are made of tin, may be conſtructed on the ſame principles as the tea-kettles deſcribed in the laſt chapter; that is to ſay, their bottoms being raiſed up about half an inch above the level of the lower part of their conical or cylindrical ſides; and being moveover made of a proper diameter to fit the ſand-rim of the furnace, they may be uſed without being made double— when they are of caſt-iron, they may be made of the ſame form below as the boiler repreſented by the figure 82, and particularly deſcribed in the laſt chapter.

Of earthen Boilers and Stew-pans proper to be uſed with Portable Furnaces.

Although the earthen ſtew-pan repreſented by the figure 74 (ſee chapter XII.) is of a good form, yet thoſe repreſented by the two following figures have likewiſe their peculiar merit. They are of forms which render them well adapted for being ſuſpended in hollow cylinders of ſheet-iron, and for their being defended by thoſe cylinders from being broken by accidental falls and blows. From a bare view of them the reader will be able to appreciate their relative merit; and alſo to diſcover the particular objects had in view in the contrivance of them. The ſecond (figure 84.) has a ſteam-rim, and conſequently may be uſed for cooking with ſteam by means of a ſteam-diſh.

Fig 83

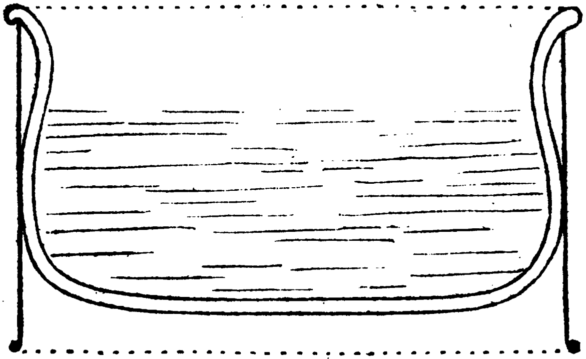
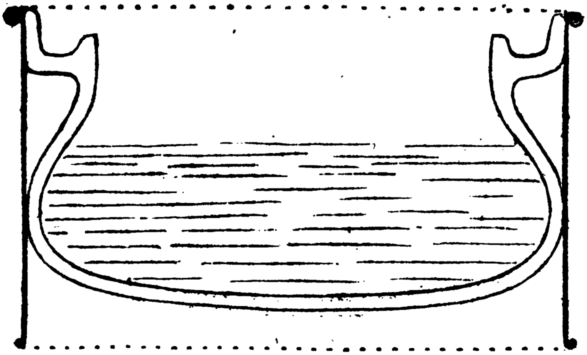
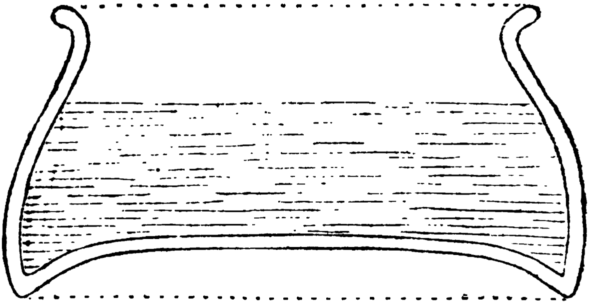


Fig 84



It would, no doubt, be very poſſible to conſtruct earthen boilers and ſtew-pans of ſuch forms as to render them capable of being uſed with portable furnaces without being ſuſpended in hollow cylinders. An earthen ſtew-pan or ſauce-pan, of the form repreſented by the following figure, would probably anſwer for that purpoſe :

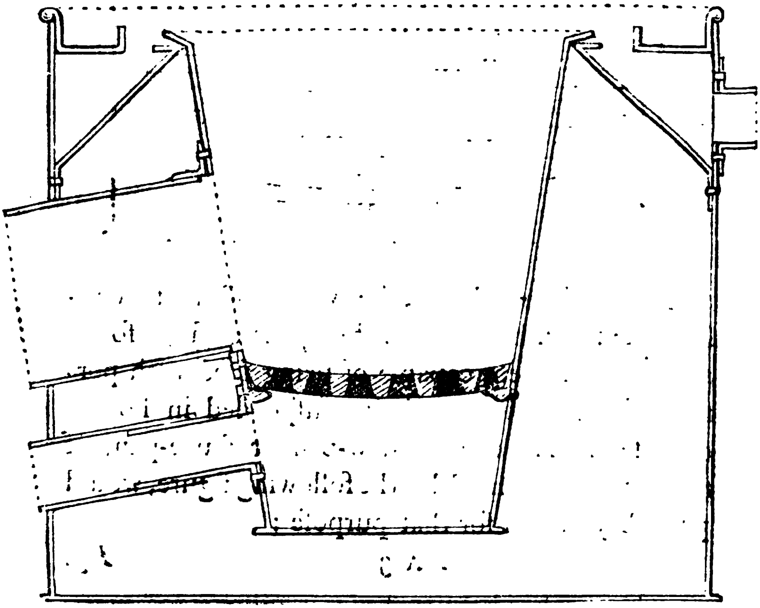
Fig. 85



Of large Portable Kitchen Furnaces, with Fire-place Doors.

The following figure repreſents a vertical ſection (drawn to a ſcale of 6 inches to the inch) of a portable furnace of this kind, conſtructed of ſheet-iron :

Fig. 86.



Furnaces of this kind might, I am confident, be made very uſeful in many caſes. Wood, coals, charcoal, or turf, might, indifferently, be uſed with them; and no contrivance is better calculated for promoting both the economy of fuel, and that of houſe-room.

Portable furnaces, on this principle, might eaſily be made of caſt-iron, which would be both cheap and durable; or, they might be conſtructed partly of caſt-iron, and partly of ſheet-iron, in the manner recommended in the eleventh chapter, in reſpect to portable furnaces without fire-place doors.

The door belonging to this fire-place is not repreſented in the foregoing figure. It may be an hollow cylindrical ſtopper made of ſheet-iron.

Deſcription of a very cheap ſquare Boiler, of ſheet-iron, ſuitable for a public Kitchen.

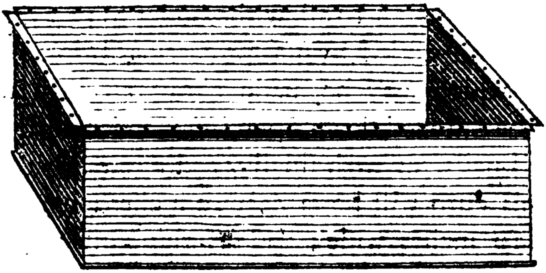
As ſome of the moſt wholeſome and nouriſhing, as well as moſt palatable kinds of food that can be prepared, are rich and ſavoury ſoups and broths; and as many of theſe can be afforded at a very low price, eſpecially when they are made in large quantities, there is no doubt but the uſe of them will become more general, and that they will in time conſtitute an eſſential, if not the principal part of the victuals furniſhed to the poor, in every country, from public kitchens; and alſo to thoſe who are lodged in hoſpitals, or confined in priſons. And, as the rich flavour, and nutritious quality—or in other words, the *goodneſs* of any ſoup, depends very much on *the manner of cooking it*;—that is to ſay, on its being boiled, or rather *ſimmered* for a long time, over a very ſlow fire, the form of the boiler, and the form of the fire-place, are both objects of great importance.

The ſimplicity and cheapneſs of the machinery, and the facility of procuring it in all places, and getting it fitted up, are alſo objects to which much attention ought to be paid. Refined improvements, which require great accuracy in the execution, and much care in the management of them, muſt not be attempted.

The boiler I would propoſe for the uſe of public kitchens, is ſimilar in all reſpects to that which has been adopted at Hamburgh, after a model ſent from Munich; for although there is nothing about this boiler that indicates the diſplay of much ingenuity in its contrivance, yet it has been found to anſwer very well as often as it has been tried; and its great ſimplicity renders it peculiarly well adapted for the uſe for which it is recommended.

A perfect idea of this boiler may be formed from the following figure, where it is repreſented without the wooden curb to which it is fixed when it is ſet in brick-work:

Fig. 87.



This boiler is 24 inches wide, 36 inches long, and 15 inches deep, conſequently, when it is filled to within 3 inches of its brim, or when the liquor in it ſtands at the depth of 12 inches, it contains 10364 cubic inches, which make above 36½ beer gallons.

It ſhould be conſtructed of ſheet-iron tinned on the inſide; and when it is not in uſe, care ſhould be taken to wipe it out very dry, with a dry cloth, to prevent its being injured by ruſt; and as often as it is put away for any conſiderable time, it ſhould be ſmeared over with freſh butter, or any other kind of animal fat, unmixed with ſalt.

The ſheet-iron will be ſufficiently thick and ſtrong if the boiler when finiſhed weigh 40 pounds; and as the beſt ſheet-iron coſts no more than about 3½ *d.* per lb. the manufacturer ought not to charge more than 6 *d.* per lb. for the boiler when finiſhed, which, if it weigh 40 lb. will amount to 20 *s.*

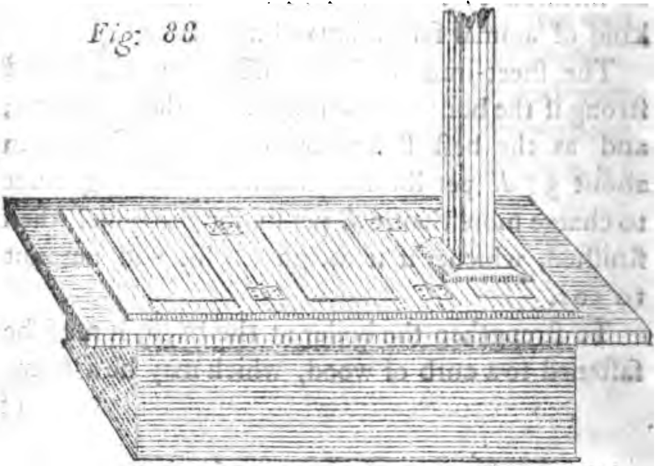
To ſtrengthen the boiler at the brim, it muſt be faſtened to a curb of wood, which may be a frame of board 1 ¼ or 1 ⅛ inch thick, 5 inches wide, and juſt large enough to allow the boiler to paſs into it, and be ſuſpended by its projecting brim. This brim, which may be made about an inch wide, muſt be faſtened down upon the wooden curb with tinned nails, or with ſmall wood ſcrews.

This curb will be 3 feet 10 inches long, and 2 feet 10 inches wide; and as the ſtuff uſed is 5 inches wide, it will meaſure very nearly 2 ¾ feet, ſuperficial meaſure, which, at 6 *d.* the foot (which would be a fair price in London for the work when done) would amount to 1 *s.* 4 ½ *d.*

The boiler muſt be furniſhed with a cover, which may be made of wood, and ſhould conſiſt of three diſtinct pieces, framed and pannelled, and united by two pair of hinges, as they are repreſented in the following figure.

This cover will meaſure about 7 ſuperficial feet, and, at 7 *d.* the foot, will coſt 4 *s.* 1 *d.* The hinges may coſt about 4 *d.* the pair, conſequently the cover will coſt, all together, about 4 *s.* 9 *d.*

Fig: 88



This figure repreſents the boiler fixed in its wooden curb, and with its cover in its place.

The firſt diviſion of the cover (which is 12 inches wide) is laid back on the ſecond (which is 14 inches wide) whenever it is neceſſary to open the boiler to put any thing into it, or to take any thing out of it, or merely to ſtir about its contents. When the boiler is to be waſhed out and cleaned, the opening into it is made larger, by throwing back the firſt and ſecond diviſions of its cover, folded one upon the other, and leaning them againſt the ſteam tube, which ſtands upon the third diviſion of the cover, which diviſion is firmly fixed down upon the curb of the boiler by means of wood ſcrews.

The ſteam tube (which ſhould be of ſufficient length to carry the ſteam from the boiler out of the room into the open air, or into a neighbouring chimney) may be made of four ſlips of ½ inch thick deal boards, faſtened together (by being grooved into each other, and nailed together) in ſuch a manner as to form an hollow ſquare trunk, meaſuring about 1 ½ inches wide in the clear.

In ſetting this boiler in brick-work, the flame and ſmoke from the fire ſhould be made to act on its bottom only, but its ſides and ends ſhould be bricked up, in order more effectually to confine the heat. The maſs of brick-work ſhould be juſt 3 feet 8 inches long, and 2 feet 8 inches wide, in order that the curb of the boiler may cover it above, and project beyond it, horizontally, on every ſide, about half an inch. The bars of the fire-place on which the fuel burns, ſhould be ſituated 12 or 14 inches below the bottom of the boiler, in order that the boiler may not be injured when the fire happens, by accident, or by miſmanagement, to be made too intenſe.

It is not neceſſary that I ſhould mention here any of the precautions which are to be obſerved in ſetting boilers of this kind in brick-work; for that ſubject has already been ſo amply treated in various parts of theſe Eſſays, that, to add any thing to what has already been ſaid upon it, could be little better than an unneceſſary and tireſome repetition.

This boiler would be ſufficiently large for cooking for about 300 perſons. If it were neceſſary to feed a much greater number from the ſame kitchen, I would rather recommend the fitting up of two or more boilers of this ſize, than conſtructing one large boiler to ſupply the place of a greater number of others of a moderate ſize; for I have found by much experience, that very large boilers are far from being either economical or convenient.

Large boilers of ſheet-iron, and eſpecially ſuch as are not kept in conſtant uſe, are always *very expenſive*, on account of their being ſo liable to be deſtroyed by ruſt.

Of Portable Boilers and Fire-places, that would be very uſeful for preparing Food for the Poor in times of Scarcity.

There is always much trouble and inconvenience, and frequently much danger in collecting together great numbers of idle people; and theſe aſſemblies are never ſo likely to produce miſchievous effects as in times of public calamity, when it is peculiarly difficult to preſerve order and ſubordination among the lower and moſt needy claſſes of ſociety.

I have often trembled at ſeeing the immenſe crowds of poor people, without occupation, who were ſometimes collected together at the doors of the great public kitchens in London during the ſcarcity of the year 1800.

Two or three hundred people may, without any conſiderable inconvenience, be ſupplied with food from the ſame kitchen; but when public kitchens are not connected with aſylums, or houſes or ſchools of induſtry, where the poor aſſemble to work during the day; and when there is no other object in view, but merely to enable the poor to purchaſe good and wholeſome food at the loweſt prices poſſible, without any interference at all with their domeſtic employments or concerns, it appears to me that it would always be beſt to ſelect from amongſt the poor a certain number of honeſt and intelligent perſons, and encourage them to prepare and ſell to their poor neighbours, under proper regulation and inſpection—ſuch kinds of food, and at ſuch prices, as ſhould be preſcribed by thoſe who have the charge of providing for the relief of the poor.

A plan of this ſort might be executed at any time on the preſſure of the moment, without the ſmalleſt delay, and almoſt without either trouble or expence, if each pariſh, or community, were to provide and keep ready in ſtore, a certain number of portable kitchen furnaces, with boilers belonging to them, to be lent out occaſionally to thoſe who ſhould be willing to undertake to cook and ſell victuals to the poor on the terms that ſhould be propoſed.

If theſe boilers were made to hold from 8 to 10 gallons, they would ſerve for preparing food for 60 or 70 perſons; and as they would require very little fuel, and ſo little attendance, that a woman who ſhould undertake the management of one of them, might perform that ſervice with great eaſe, by devoting to it each day the labour of half an hour, and giving to it occaſionally a few moments of attention, which would hardly interrupt her in her common domeſtic employments; this method of preparing food would be very economical—perhaps more ſo than any other;—and, with proper inſpection, it would be little liable to abuſe.

How very uſeful would theſe portable boilers and furnaces be for providing a warm and cheap dinner for children who frequent ſchools of induſtry?

No furnace could, in my opinion, be better contrived for this uſe than that repreſented in the figure 86, and the boiler might be made either of ſheet-iron tinned, or of copper tinned, or of caſt-iron. It cannot be neceſſary that I ſhould give any particular directions reſpecting its form;—and its dimenſions may eaſily be computed from its capacity, when that is determined on.

A portable cooking apparatus of this kind, which is deſigned as a model for imitation, may be ſeen in the repoſitory of the Royal Inſtitution.

Of the economy of Houſe-room in the arrangement of a Kitchen for a large Family.

There is nothing which marks the progreſs of civil ſociety more ſtrongly than the uſe that is made of houſe-room; and nothing would tend more to prevent the too rapid progreſs of deſtructive luxury among the induſtrious claſſes, than a taſte for neatneſs and true elegance in all the inferior details of domeſtic arrangement. The pleaſing occupation which thoſe objects of rational purſuit afford to the mind, fills up leiſure time in a manner that is both uſeful and ſatisfactory, and prevents *ennui*, and all its fatal conſequences.

The Poor cook their victuals in the rooms in which they dwell; but thoſe who can afford the expence—and many indeed who cannot—ſet apart a room for the purpoſe of cooking, and call it a kitchen. I am far from deſiring to alter this order of things, for I think it perfectly proper. What I wiſh is, that each claſs of ſociety may be made as comfortable as poſſible, and that all their domeſtic arrangements may be *neat* and *elegant*, and at the ſame time *economical*.

I always fancy that teaching induſtrious people economy, and giving them a taſte for the improvement of all thoſe uſeful contrivances, and rational enjoyments, that are within their reach, is ſomething

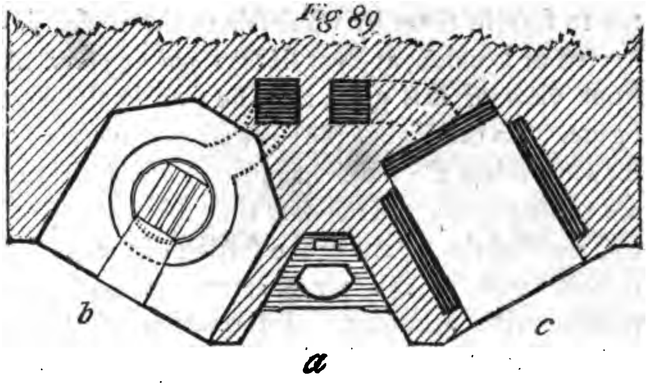
thing like ſhewing them how—without either toil or trouble—and with a good conſcience—they may obtain all thoſe advantages which riches command, together with many other very ſweet enjoyments which money cannot buy. And whoſe heart is ſo cold as not to glow with ardent zeal at a proſpect ſo well calculated to awaken all the moſt generous feelings of humanity?

But to return from this digreſſion:—There are various methods that may be uſed for economizing houſe-room, in making the neceſſary arrangements for cooking. If the family be ſmall, the uſe of portable furnaces and boilers will be found to be very advantageous.

For a large family I would recommend what I ſhall call a *concealed kitchen:* There are two very complete kitchens of this kind, which have been fitted up, under my direction, at the Royal Inſtitution;—the one, which is ſmall,—is in the houſekeeper's room; the other is in the great kitchen. Theſe were both made as models for imitation, and may be examined by any perſon who wiſhes to ſee them.

There are alſo two kitchens of this kind in my houſe at Brompton, in two adjoining rooms; which have been fitted up principally with a view to ſhewing that all the different proceſſes of cookery *may* be carried on in a room, which, on entering it, nobody would ſuſpect to be a kitchen. The following figure is the ground plan of one of them:

Fig 89



a is the opening of the fire-place, which is brought forward into the room about 14½ inches. This was done in order to give more room for the family boiler, which is ſituated at *b*, and the roaſter, which is placed on the other ſide of the open chimney fire-place at *c*.

The two broad ſpaces on the two ſides of the roaſter, by which the ſmoke from the fire below it riſes up round it; and another at the farther end of it, by which the ſmoke deſcends, are diſtinguiſhed by dark ſhades, as are alſo the two ſquare canals by which the ſmoke from the roaſter, and that from the boiler, riſes up into the chimney.

The top of the grate is ſeen which belongs to the open chimney fire-place; it is repreſented by horizontal lines. It is what I have called a *cottage grate*, and what is ſold in the ſhops under that name. The retail price of this grate, with its fender and trivet, is *ten ſhillings and ſix pence.* The Carron Company entered into an engagement with me to furniſh them by wholeſale to the trade, delivered in London, at *ſeven ſhillings and ſix pence*. A front view of this grate may be ſeen in the next figure. As this figure (89) is deſigned merely for ſhewing *where* the different parts of the apparatus are to be placed, and not *how* they are to be fitted up, none of the details of the ſetting of the roaſter or boiler were in this place attempted to be expreſſed with accuracy. Information reſpecting thoſe particulars muſt be collected from other parts of the work.

The grate repreſented in this figure is calculated for boiling a pot, or a tea-kettle, and for heating flat-irons for ironing. Its bottom is ſo contrived as to be eaſily taken away, and replaced. By removing it at night, or whenever a fire is no longer wanted, the coals in the grate fall down on the hearth, and the fire immediately goes out. This contrivance not only ſaves much fuel, which otherwiſe would be conſumed to waſte, but it is alſo very convenient on another account: As all the coals and aſhes fall out of the grate when its bottom is removed, on replacing it again the grate is empty, and ready for a new fire to be kindled in it.

The top of this grate, which is a flat plate of caſt-iron, has one large hole in it for allowing the ſmoke to paſs upwards, and another, behind it, which is much ſmaller, through which it is forced to *deſcend* into what has been called a *diving flue*, whenever the boiler belonging to this fire-place is uſed; which boiler is ſuſpended in an hollow cylinder of ſheet-iron, about 11½ inches in diameter, reſembling in all reſpects the boilers uſed with the regiſter-ſtoves deſcribed in the tenth chapter of this eſſay.

I intend, as ſoon as it ſhall be in my power, to publiſh a particular detailed account of this grate, and alſo of ſeveral others, for open chimney fire-places, which, at my recommendation, have lately been introduced in this country; in the mean time I avail myſelf of this opportunity of pointing out one fault which has been committed by almoſt all thoſe who have undertaken to ſet *cottage-grates* in brick-work: they have made what has been called the *diving flue* much too deep. It is more than probable that the name given to this flue has contributed not a little to lead them into this error. When properly conſtructed it hardly deſerves the name of *a flue*, for it ought not to be above *two inches deep*, meaſured from the under ſurface of the flat plate of caſt-iron, which forms the top of the grate. There are two important advantages that reſult from making this opening in the brick-work for the paſſage of the ſmoke *very ſhallow*;—the one is, that in this caſe it may eaſily be cleaned out, when coals happen to fall into it, by accident, when it is left uncovered;—and the other is, that the back wall of the fire-place, againſt which the fuel burns, may, in that caſe, be made thick and ſtrong, and not ſo liable to be deſtroyed by the end of the poker in ſtirring the fire, as it is when there is an hollow flue juſt behind it.

Both theſe are important objects, and for want of due attention being paid to them, cottage grates have, to my knowledge, often been diſgraced and rejected. When they are properly ſet and properly managed, they are very uſeful fire-places where coal or turf is burnt; and it never was deſigned that they ſhould be uſed with wood.

When kitchens are fitted up on the plan here recommended, in places where wood is uſed as fuel, the open chimney fire-place, which is ſituated between the roaſter and the boiler, may be conſtructed *of the form* repreſented in the foregoing figure, but without any fixed grate; and the wood may be burnt on andirons, or on a ſmall moveable *gridiron-grate* placed on the hearth.

Theſe *gridiron-grates* are very ſimple in their conſtruction, cheap, and durable; and they make an excellent fire, either with coals or turf, or with wood, if it be ſawed or cut into ſhort billets. Five of theſe grates may be ſeen at the houſe of the Royal Inſtitution; one in the great lecture-room, one in the apparatus-room, one in the manager's-room, one in the clerks room, and one in the dining-room. They have hitherto been made of two ſizes only, namely, of 16 inches and of 18 inches in width, in front. The width of the back part of the grate is always made juſt equal to half its width in front, and the two ſloping ſides, or ends of the grate, are each juſt equal in width to the back. The form and dimenſions of the grate determines the form and dimenſions of the open

chimney

chimney fire-place in which it is uſed, for the back of the fire-place muſt always be made juſt equal in width to the back of the grate, and the ſloping of the covings muſt be the ſame as the ſloping of the ends of the grate.

From what has been ſaid of the proportions of the front, back, and ſides of theſe grates, it is evident that the covings and backs of their fire-places muſt make an angle with each other juſt equal to 120 degrees. This angle I have been induced to prefer to one of 135 degrees, which I formerly recommended for open chimney fire-places: the reaſons for this preference will be fully explained in another place. To give them here would take up too much time, and would moreover be foreign to my preſent ſubject.

For the information of the public, and to prevent, in as far as it is in my power, exorbitant demands being made for theſe uſeful articles, I would juſt obſerve, that the ſmalleſt, or 16 inch *gridiron-grate*, together with all the apparatus belonging to it, ought to coſt, *by retail*, no more than *ſeven ſhillings*. This apparatus conſiſts of a caſt-iron fender; a trivet for ſupporting a boiler or a tea-kettle over the fire; and a ſmall plate of caſt-iron (to be faſtened into the back of the chimney) by means of which, and a ſmall bolt or nail, the grate is faſtened in its place on the hearth.

The ſecond ſized, or 18 inch *gridiron-grate*, with all its apparatus (conſiſting of the three articles mentioned above) ought to be ſold, by retail, for *ſeven ſhillings and ſix pence.*

The

The *wholeſale price* of theſe articles, at the Carron Company's warehouſe in London (Thames-ſtreet, near Blackfriar's-bridge) to the trade; and to gentlemen who buy them by the dozen to diſtribute them to the poor, is

For the gridiron-grate, N° 1. with the articles belonging to it	*four ſhillings.*
For that N° 2, with the articles belonging to it - - - -	*four ſhillings and ſix pence.*

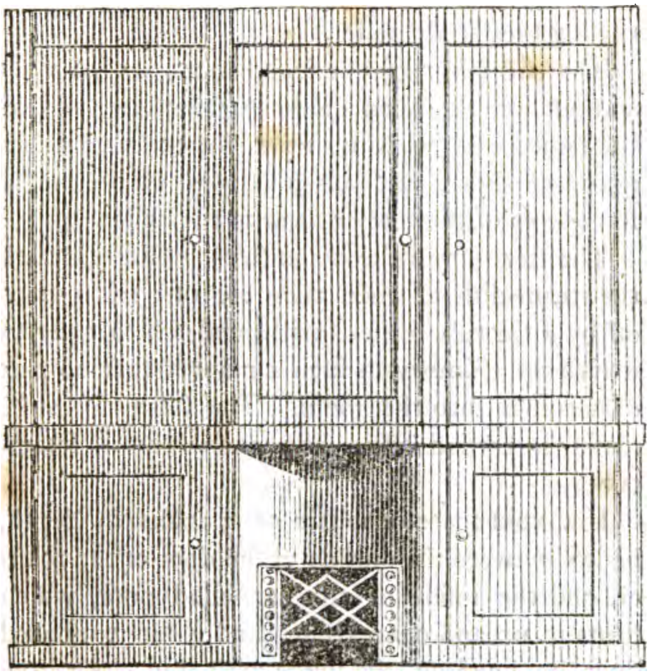
Theſe are the wholeſale and retail prices which I fixed with the agent of the Carron Company, at their works in Scotland, in the autumn of the year 1800, when I made a journey there for the purpoſe of eſtabliſhing theſe regulations; and when I made a preſent to the Company of all my patterns which I had got made in London, and which had been rendered as perfect as poſſible by previous experiments—namely, by getting caſtings taken from them by the beſt London founders, and altering them occaſionally, till they were acknowledged to be quite complete.

If it had been poſſible for me to have done more to prevent impoſitions, I ſhould have done it with pleaſure; and I ſhould have felt at the ſame time that I had done no more than what it was my duty to do.

But to return from this long digreſſion;—I ſhall now haſten to finiſh my account of the means which have been uſed in one of the rooms in my houſe (that deſtined for the large kitchen) for concealing the roaſter and the family boiler.

The following figure is an elevation of that part of the ſide of the room where theſe implements are concealed:

Fig. 90



The open chimney fire-place, and the front of the grate, are diſtinctly ſhewn in the middle of this figure, in the lower part of it. The pannelled door, immediately above the mantle of the chimney fire-place, which reaches nearly to the ceiling of the room, ſerves to ſhut up a ſmall cloſet, with narrow ſhelves, which has no connection with culinary affairs, but is uſed for putting away candle-

ſticks,

ſticks, and any other ſmall articles uſed in houſekeeping, which are occaſionally laid by when not in actual uſe. The two other pannelled doors by the ſide of it ſerve, the one (that on the right hand) for concealing the roaſter—and the other for concealing the family boiler.

The two (ſhorter) pannelled doors, on the right and left of the open chimney fire-place, and on the ſame level with it, ſerve for concealing the fire-place doors, and aſh-pit doors of the cloſed fire-places of the roaſter, and of the boiler.

The ſteam from the boiler (after paſſing through the ſteam-diſhes, when they are uſed) is carried off by a tin tube into a ſmall canal, which conveys it into the chimney in ſuch a manner that no part of it comes into the room. The ſteam from the roaſter is carried off in like manner by its ſteam-tube.

If a void ſpace, about 2 or 3 inches in depth, be left between the outſide of the door of the roaſter, and the inſide of the pannelled door, which ſhuts it up and conceals it, and if this pannelled door, be lined on the inſide with thin ſheet-iron, the proceſs of roaſting may be carried on, with perfect ſafety, with this door ſhut. And if ſimilar precautions be uſed to defend the other pannelled doors from the heat, they may alſo be kept ſhut, while the proceſſes of boiling and roaſting are actually going on.

By theſe means it would be *poſſible* to prepare a dinner for a large company in a room where there ſhould be no appearance of any cooking going on. But I lay no ſtreſs on this particular advantage reſulting from this arrangement of the culinary apparatus. The real advantage gained by it is this, that the kitchen is left an *habitable*, and even an *elegant room*, when the buſineſs of cooking is over.

The kitchen in Heriot's Hoſpital at Edinburgh, which was fitted up in the autumn of the year 1800, is arranged in this manner; with this difference however, that all the pannelled doors are omitted. The boiler is ſhut up by a door of ſheet-iron, japanned; and the door of the roaſter, and the two fire-place doors, and two aſh-pit regiſter doors, are expoſed to view.

As the brick-work is white waſhed, and kept clean, and as the doors are all either japanned black or kept very clean, the whole has a neat appearance.

The roaſter and principal boiler in the great kitchen of the houſe of the Royal Inſtitution, are put up nearly in the ſame manner as thoſe in Heriot's Hoſpital, excepting, that in the former there is a hot-cloſet, which is ſituated immediately above the roaſter, whereas there is none belonging to the latter.

In one of the kitchens in my houſe, there is—in the place of the roaſter—a roaſting oven, with a common iron oven of the ſame dimenſions placed directly over it, and heated by the ſame fire.

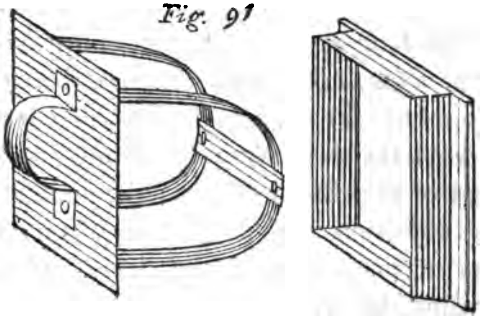
The door of my roaſter, and that of my roaſting oven, are made ſingle, of thin ſheet-iron, and they are covered on the outſide with pannels of wood, for confining the heat. Inſtead of doors to their cloſed fire-places, I uſe ſquare ſtoppers, made of fire-ſtone, or hard fire-brick, faſtened to flat pieces of ſheet-iron; to which knobs of wood are fixed, which ſerve inſtead of handles.

Theſe ſtoppers anſwer for confining the heat quite as well, and perhaps even better, than double doors, and they coſt much leſs. They are fitted into ſquare frames of caſt-iron, (nearly ſimilar to that repreſented in the figure 91) which are firmly fixed in the brick work by means of projecting flanches, which are caſt with them. The front edge of this frame, or door-way, is ground, and made perfectly level, and the plate of ſheet-iron which forms a part of the ſtopper being made quite flat, ſhuts againſt the front edge of this door-way, and cloſes the entrance into the fire-place with the greateſt accuracy.

The entrance into the aſh-pit is likewiſe cloſed by a ſtopper, which is ſo contrived as to ſerve occaſionally as a regiſter for regulating the quantity of air admitted into the fire-place.

As this *Regiſter-ſtopper*, for the aſh-pit of a ſmall cloſed fire-place, is very ſimple in its conſtruction, and as I have found it to anſwer very well the purpoſe for which it was contrived, I ſhall preſent the reader with the following ſketch of it; which will, I truſt, be ſufficient to enable a workman of common ingenuity to conſtruct, without difficulty, the thing which is repreſented.

Fig. 91



The box, with a flanch at each of its ends, forms the door-way into the aſh-pit; it is of caſt-iron, and its opening in front is 7¼ inches wide, and 3¾ inches high. It is concealed in the brick-work in ſuch a manner that its front edge only is ſeen, projecting about ⅛ of an inch before the brick-work.

When the regiſter-ſtopper belonging to this door-way, (which is ſhewn in this figure) is puſhed quite home, its flat plate comes into contact with the front edge of the door-way, and cloſes the paſſage into the aſh-pit ſo completely that no air can enter. By withdrawing this ſtopper more or leſs, more or leſs air is admitted.—The narrow, thin, elaſtic bands of iron, the ends of which are faſtened by rivets to the flat plate of the ſtopper, ſerve to confine the ſtopper in any ſituation in which it is placed, which ſervice they are enabled to perform (in conſequence of their elaſticity, and of their peculiar ſhape) by preſſing againſt the ſides of the door-way.

The only objection, that I am acquainted with, to this kind of regiſter for the door-way of the aſh-pit of a ſmall cloſed fire-place, is, that it is not quite ſo eaſy to ſee the preciſe ſtate of the regiſter as it is when the air is admitted through an hole in the front of the aſh-pit door, in the uſual manner; but this objection is of no great importance, eſpecially as means may eaſily be deviſed to remedy that trifling defect.

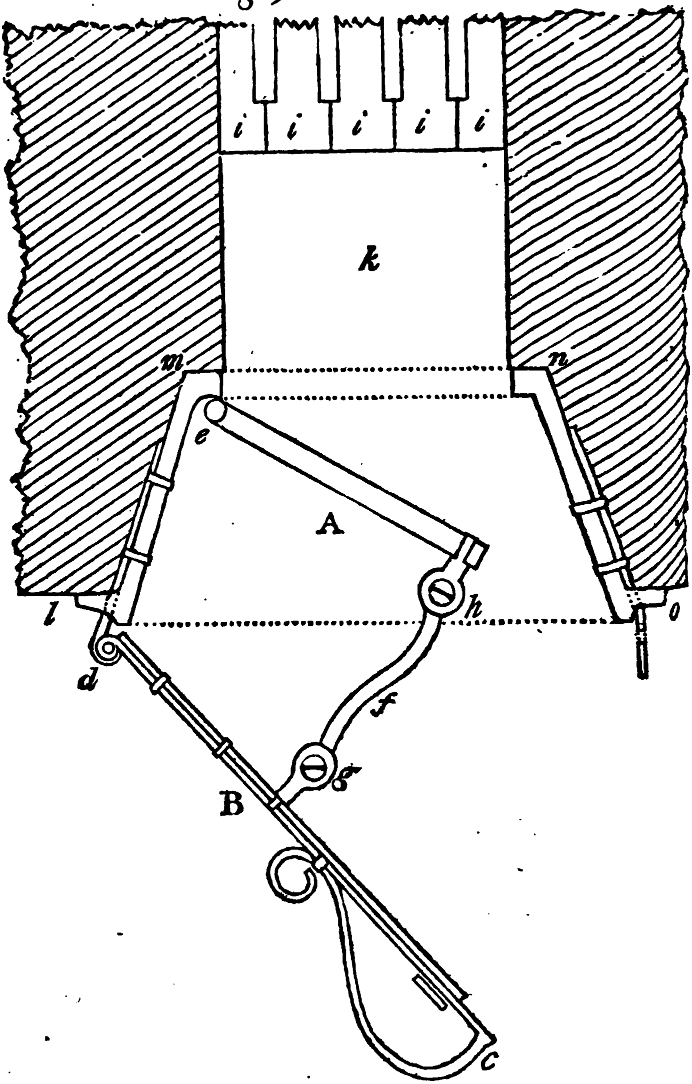
The door-way frames to all the cloſed fire-places in my own kitchen, are in all reſpects like that repreſented in the foregoing figure (91) with this difference only, that they are 5 inches high inſtead of being 3½ inches in height. An account has already been given of the manner in which their ſtoppers were conſtructed.

It is right that the reader ſhould be informed, that although I have made uſe of ſtoppers to cloſe the paſſage into each of the cloſed fire-places in my own kitchen, yet very few perſons have adopted this ſimple and cheap contrivance. The reaſon why it has not come into more general uſe might eaſily be explained; but I fancy it will be beſt that I ſhould ſay nothing now on that ſubject. Inſtead of recommending what nobody would find much advantage in furniſhing at a fair price, it will be more wiſe and prudent to give a ſhort deſcription of a more complicated, more elegant, and more expenſive contrivance, which has already found its way into the ſhops of ſeveral of the moſt reſpectable ironmongers in London: As this contrivance has often been uſed, and has always been found to anſwer perfectly well, I can venture to recommend it to all thoſe to whom an additional expence of a few ſhillings, or a guinea or two, in fitting up a kitchen, is not conſidered as an object of importance.

A ſhort deſcription of a DOUBLE-DOOR *for a cloſed fire-place.*

The following figure (which is drawn to a ſcale of four inches to the inch) repreſents an horizontal ſection of one of theſe double-doors, and alſo of a part of the brick-work in which it is ſet:

Fig 92



A, is the inſide door, and B is the outſide door —

—Theſe doors are ſo connected, by means of a crooked rod of iron *f*, and the two joints *g* and *h*, that when the outſide door is opened, or ſhut, the inſide door is neceſſarily opened, or ſhut, at the ſame time. The inſide door, which is of caſt-iron, and near ½ an inch in thickneſs, is moveable on two pivots, one of which is repreſented at *e*. The outſide door is moveable on two hinges, one of which is ſhewn at *d*.

c, is the latch by which the outſide door is faſtened. This is of ſuch a form that it may be uſed as a latch, and may ſerve at the ſame time as an handle for opening and ſhutting the door.

The door-way, which is of caſt-iron, is in the ſhape of an hollow truncated quadrangular pyramid, with a flanch in front, about an inch wide; which flanch, when ſeen in front, ſeems to form a kind of frame to the outſide door, the flanch, which is about ¼ of an inch in thickneſs, projecting before the vertical front of the brick-work.

l, *m*, *n*, *o*, repreſents an horizontal ſection of this caſt-iron door-way. The brick-work in which it is ſet is diſtinguiſhed by diagonal lines.

k, is the paſſage leading to the fire-place; it is 6 inches wide, in the clear, from *m* to *n*;—5 inches high, and 6 inches long; meaſured from the inſide of the inſide door, when it is ſhut, to the hither ends of the openings between the iron bars of the fire-place; through which openings the air comes up from the aſh-pit into the fire-place. The hither ends of theſe bars, (five in number) are repreſented in the figure: They are each diſtinguiſhed by the letter *i*.

The opening of the inſide door-way is 6 inches wide, and 5 inches high in the clear; and the door itſelf is $6\frac{1}{2}$ inches wide, and $5\frac{1}{2}$ inches high.

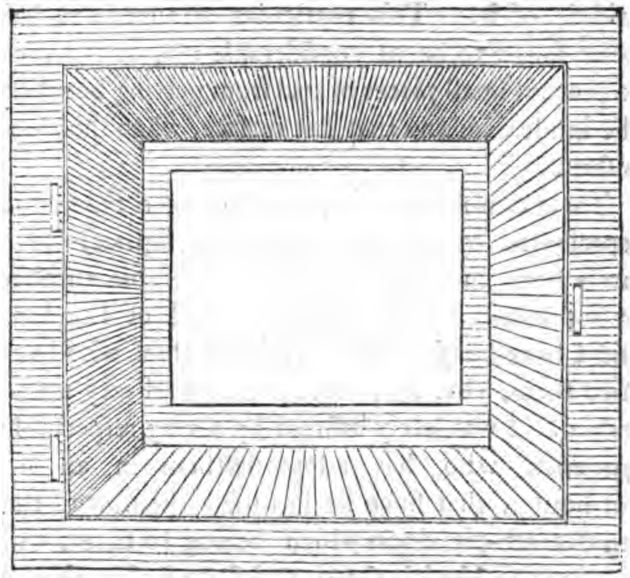
The outſide door-way is 10 inches wide, and 9 inches high, in the clear; and the door, which is about $\frac{2}{10}$ of an inch in thickneſs, is $10\frac{1}{2}$ inches wide, and $9\frac{1}{2}$ high. The extreme width of the door-frame to the outward edge of the flanch is $12\frac{1}{2}$ inches, and its extreme height is $11\frac{1}{2}$ inches.

The two ſtraps of iron to which the hooks of the hinges of the outſide door are faſtened, paſs through two holes in the flanch, provided for them in caſting the door-way, and are rivetted to the ſloping ſide of the door-way on the left hand ſide of it.

Theſe holes are each $\frac{7}{8}$ of an inch in length from top to bottom, and about $\frac{1}{4}$ of an inch in width. There is another ſimilar hole in the flanch on the oppoſite ſide of the door-way, through which a ſtrap of iron paſſes, the end of which projecting forward before the level of the front edge of the door-way, ſerves as a catch or hook, into which the latch of the door falls, when the door is cloſed.

Theſe three holes in the ſide flanches of the door-way are diſtinctly repreſented in the following figure, which is an elevation, or front view of this door-way, without its doors:

Fig. 93



It appears by this figure, but ſtill more diſtinctly by the laſt (92.) that the flanch or front of this door-way is not quite flat. It is raiſed at its inward edge, which projects forward about ¼ of an inch. This projecting rim, which is caſt as thin as poſſible, is ground upon a flat ſand-ſtone, and made quite level, in order that the outſide door, which is flat, by ſhutting againſt the front of this projecting edge, may cloſe the opening into the fire-place with the greateſt poſſible accuracy.

It will likewiſe be remarked on examining this figure (93.) with attention, that the opening which is cloſed by the inſide door is not preciſely in the middle of the vertical flat ſurface againſt which that door ſhuts, being ſituated a little above the middle of it. This particular arrangement has been found to be of conſiderable uſe, as it ſerves to prevent ſmall pieces of coal from getting between the inſide door and that flat ſurface, when the door is ſhut.

Theſe double doors (of a ſize larger than that repreſented by the two preceding figures) have lately been introduced in a conſiderable number of hot-houſes in the neighbourhood of London; and I have been told by ſeveral perſons who have tried them, that they have been found very uſeful indeed. I was lately aſſured by a very reſpectable gardener, who has adopted them in all his hot-houſes, that ſince he has uſed them, and the regiſter aſh-pit doors which belong to them, and are always ſold with them, and ſince he has altered the conſtruction of his fire-places, his conſumption of coals has been little more than half as much as it uſed formerly to be.

In ſetting theſe double doors in brick-work, great care ſhould always be taken to make the entrance into the fire-place of ſome conſiderable length, or to keep the hither ends of the iron bars on which the fuel burns, at ſome diſtance from the inſide door; otherwiſe, if the burning fuel be near that door, it will heat it and its frame red hot, which will ſoon deſtroy their form, and prevent the door from cloſing the entrance of the fire-place with accuracy.

I have found it to be a good general rule to place the hither ends of the bars, which form the grate of the fire-place, as far beyond the inſide door, as that door-way is wide, in the clear. And it will be found to be an excellent precaution to defend the door from the heat, if that part of the paſſage into the fire-place which lies beyond the inſide door, be kept conſtantly rammed quite full of ſmall coals; or, what would be ſtill better, of coal-duſt, mixed up with a certain proportion of moiſt clay.

I have already, in a former part of this Eſſay, mentioned how neceſſary it is in ſetting double doors in brick-work, to take care to *maſk* the farther end of the door-way, in ſuch a manner (by means of bricks interpoſed before it, or between it and the fire) that the rays from the burning fuel may never fall on it. The manner in which this is to be done is clearly repreſented in the figure 92.

All theſe precautions for preventing theſe double doors from being injured by exceſſive heat, will be the more neceſſary in proportion as the fire-places are larger to which they belong.

There is one eſſential part of this apparatus, which, for want of room, was omitted in the two laſt figures;—that is, the ſtraps of wrought iron, by means of which the door-way is firmly fixed in the brick-work; but this omiſſion can be of no conſequence, as every common artificer will know, without any particular directions, how that part of the work ſhould be executed. Theſe ſtraps muſt of courſe be faſtened to the caſt-iron door-way by means of rivets.

CHAP. XV.

Apology for the great length of this Eſſay.—Regret of the Author that he has not been able to publiſh plans and deſcriptions of the various culinary inventions that have lately been put up in the Kitchen belonging to the Houſe of the Royal Inſtitution, and in the Kitchen of Heriot's Hoſpital at Edinburgh.—A ſhort account of a BOILER, *on a new conſtruction, lately put up at the Houſe of the Royal Inſtitution, for the purpoſe of* GENERATING STEAM *for warming the Great Lecture Room.—This Boiler would probably be found very uſeful for* STEAM ENGINES.—*An account of a Contrivance for preventing metallic* STEAM-TUBES *from being injured by the alternate expanſion and contraction of the metal by heat and cold.—An account of a ſimple Contrivance which ſerves as a ſubſtitute for* SAFETY-VALVES.

I CANNOT finiſh this Eſſay without apologizing for the great length of it. I had no idea when I began it that it would ever have grown to ſuch a voluminous ſize, but I am not conſcious of having inſerted any thing that could well have been omitted.

I was very deſirous of laying before the Public compleat plans and deſcriptions of the various culinary inventions that have lately been put up in the Great Kitchen of the houſe of the Royal Inſtitution, in Albemarle-ſtreet; and alſo of thoſe erected in Heriot's Hoſpital at Edinburgh, in the autumn of the year 1800; but my ſtay in this country will be too ſhort for me to undertake ſo conſiderable a work at this time. I am happy, however, that theſe new contrivances, ſome of which have already been proved to be very uſeful, are ſituated in places of public reſort, where perſons deſirous of examining them may at all times obtain free admiſſion.

There are alſo ſeveral other new and uſeful contrivances at the houſe of the Royal Inſtitution, which I ſhould have had great pleaſure in laying before the public, had it been in my power; as I am perſuaded that correct accounts of them would have been very acceptable to men of ſcience, and to all thoſe who take pleaſure in promoting new and uſeful mechanical improvements.

I ſhould, in particular, have been very glad to have given plans and deſcriptions of all the various parts of the ſteam-apparatus that has been put up for the purpoſe of warming the Great Lecture Room. The boilers for generating the ſteam are, if I am not much miſtaken, well worthy of the attention of thoſe who make uſe of ſteam-engines; and as the ſubject is of infinite importance in this great manufacturing country, where the numerous advantages which reſult from the uſe of machinery are known, and every day more and more felt by individuals, and by the public, I cannot reſiſt the ſtrong inclination which I feel, to attempt, in a few words, to give a general idea of this contrivance. Thoſe who wiſh to know more of the matter, may get all the information reſpecting it which they can want, by applying at the houſe of the Royal Inſtitution.

A ſhort account of the BOILERS *lately put up at the Houſe of the Royal Inſtitution for* GENERATING STEAM *for warming the Great Lecture Room.*

Over an oblong cloſed fire-place, furniſhed with double doors, aſh-pit regiſter door, &c. are placed two cylinders of copper, laid down horizontally, by the ſide of each other, over the fire, each cylinder being 15 inches in diameter and 48 inches long.—Immediately over theſe two cylinders, and reſting on them, are placed two other cylinders of copper, of the ſame length and diameter; and over theſe laſt, and reſting on *them*, are placed two other like cylinders, making ſix cylinders in the whole, all made of the ſame material, and being of the ſame dimenſions.

The fire-place being ſituated under the hither ends of the two lower cylinders, the flame runs along under them to their farther ends, where it paſſes upwards, and comes forward between the upper ſide of the two lower cylinders, and the lower ſides of the two cylinders immediately above them. Being arrived at the front wall of the brick-work, it there riſes up again, and then paſſes along horizontally between the two middle cylinders, and the two upper cylinders, till it comes to the back wall; and, paſſing up by the farther ends of the upper cylinders, it comes forwards horizontally, for the laſt time, in an arch, or vault of brick-work, which covers the two upper cylinders. Being arrived once more at the front wall of the brick-work, it there enters a canal, (furniſhed with a good damper) by which it goes off into a neighbouring chimney.

Theſe cylinders are confined in their places by being placed in pairs, over each other, between two parallel vertical walls, which are built juſt ſo far aſunder as to admit two cylinders, placed horizontally, by the ſides of each other; and the flame is prevented from finding its way upwards between the two cylinders which lye by the ſides of each other, or between the outſides of thoſe cylinders and the ſides of the vertical walls with which they are in contact, by filling up the joining between them with good clay, mixed with ſmall pieces of fire-bricks.

The farther ends of all the cylinders are cloſed up, and all the tubes which are neceſſary for the admiſſion of water, and for the paſſage of the ſteam, are fixed to a circular plate of metal which cloſes, (by means of flanches and ſcrews) the front ends of the cylinders.

In conſequence of this particular arrangement it will be perfectly eaſy to make all the cylinders of *caſt-iron*, even when theſe boilers are deſtined for ſteam-engines of the largeſt dimenſions. The number of ſets of cylindrical boilers, which in each caſe it will be neceſſary to put up, muſt be determined by the ſize of the cylinders, and by the quantity of ſteam that will be wanted. Six cylindrical boilers put up in a ſeperate maſs of brick-work, in the manner above deſcribed, I call *one ſet*.

It will always be found to be very advantageous to have at leaſt three or four ſets of cylindrical boilers to each ſteam engine, inſtead of having one ſet of larger cylinders; and this not only on account of the wear and tear of ſmall fire-places being incomparably leſs expenſive than in thoſe which are large; but alſo on account of the economy of fuel which will be derived from that arrangement, and the great convenience that will be found to reſult from the uſe of ſmall boilers, which may at any time be heated and made to boil in a very few minutes; and from the advantage of being able at all times to regulate the number of ſets of boilers in uſe, to the load on the engine.

It is quite impoſſible to make a ſmall fire in a large fire-place, without a great loſs of heat; but by having a number of ſmall ſeparate fire-places, an engine may be made to work with a light load, with almoſt as ſmall a proportion of fuel as when it is made to perform its full work.—But to return to our cylindrical boilers.

The two lower cylinders, and thoſe two which lie immediately over them, being deſtined for the generation of ſteam, are kept conſtantly about half full of water, which water they receive, already hot, from the two upper cylinders; in which laſt the water ſhould never boil.

Theſe upper cylinders communicate, by an open pipe, with a reſervoir of water which is ſituated ſeveral feet above them, conſequently, as faſt as they furniſh water to the four cylinders which lie below them, that water, ſo furniſhed, is immediately replaced by water which comes from the reſervoir above.

As the pipe which brings this water from the reſervoir enters the cylinders ſome conſiderable diſtance below their centers, and as the pipes which convey the water from them to the cylinders below are fixed in their centers, as cold water is heavier than warm water, it is evident that the water which enters them cold from the reſervoir, will take its place at the lower parts of theſe cylinders, while only the lighter, hot water, will be furniſhed to the cylindrical boilers below.

The method of regulating the admiſſion of water into the boilers below, where the ſteam is generated, is ſo well known, that it would be ſuperfluous to give a particular account of it.

In the ſet of boilers that has been put up at the houſe of the Royal Inſtitution, the open ends of all the cylinders are on one ſide, that is to ſay, they all come through the *front wall* of the brickwork. This arrangement was rendered neceſſary in that particular caſe, by local circumſtances; it would however have been better if only the lower and upper pairs of cylinders had come through the front wall, and the open ends of the middle pair had paſſed through the back wall; for in that caſe it would have been eaſier to provide a paſſage for the flame round the ends of the middle cylinders.

One evident advantage that will be derived from conſtructing ſteam-engine boilers on the principles here recommended is, their ſuperior ſtrength to reſiſt the efforts of the ſteam; which will render it poſſible to uſe very thin ſheet-copper, or ſheet-iron, in conſtructing them, when they are made of thoſe materials. Another advantage will be the great facility of removing and repairing any of the cylinders which may happen to leak, or which may be found to be damaged, or worn out. When ſeveral ſets of cylinders are put up for the ſame engine (which I would always recommend, even for engines of the ſmalleſt ſize) any of theſe occaſional repairs may be made without ſtopping the engine.

If theſe cylindrical ſteam boilers ſhould be found to be uſeful for ſteam engines, they cannot fail to be equally ſo for generating ſteam for heating dyers coppers by means of ſteam,—for bleaching by means of ſteam; and in general for every purpoſe where ſteam is wanted in large quantities.

They muſt, I think, be peculiarly well adapted for dyers; for as water leſs hot than boiling water

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the upper cylinders will at all times
ſupply of warm water; which
ſmalleſt inconvenience, be
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deſcends and enters the water,
plunged to a certain depth below the
of the water.

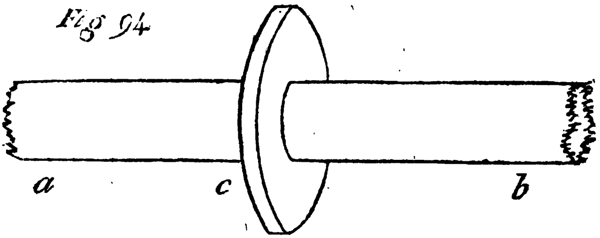
ſhall finiſh this chapter, and conclude this eſſay, by giving a ſhort deſcription of two very ſimple contrivances, which have been put in practice at the houſe of the Royal Inſtitution, and which have been found to be very uſeful. The one is a contrivance for preventing moſt effectually the bad effects of the alternate expanſion and contraction by heat and cold of the metallic tubes which are uſed in conveying ſteam to a conſiderable diſtance; and the other is a ſubſtitute for ſafety-valves in an apparatus for heating rooms by means of ſteam.

Of the means that may be uſed for preventing metallic ſteam-tubes, of conſiderable length, from being injured by the alternate expanſion and contraction of the metal by the different degrees of heat and cold to which thoſe tubes are occaſionally expoſed.

We will ſuppoſe the tube in queſtion to be of copper, and eight inches in diameter (which is the ſize of that uſed for warming the Great Lecture Room at the Royal Inſtitution). Let this tube be made in lengths of ten feet, and inſtead of joining the ends of theſe tubes together, immediately, to form one long tube, let a very ſhort tube, or cylinder, of only one or two inches in length, and 24 inches in diameter, cloſed at each end with a flat circular plate of ſheet-copper, like the head of a drum, be interpoſed between their joinings. Theſe two circular ſheets of copper, which form two ends of this very ſhort cylinder, muſt be perforated in their centers with holes eight inches in diameter, to give a paſſage to the ſteam, and the ends of the tubes muſt be firmly faſtened to them by means of flanches and rivets.

The following figure, which repreſents an outline of a portion of a ſteam-tube conſtructed in this manner, will give a clear idea of this contrivance.

Fig 94



a, *b*, are portions of two of the tubes which are united together by means of the ſhort flat cylinder *c*.

Now if we ſuppoſe one of theſe tubes (10 feet long) to be immoveably fixed *in the middle of its length* to a beam of wood, or to a ſolid wall, the increaſe or diminution of the length of each half of it, ariſing from its being occaſionally heated to the temperature of boiling water, by ſteam, or cooled to the mean temperature of the air of the atmoſphere, being free, will cauſe its two ends to puſh inwards, or to draw outwards, the two flat ends of the two neighbouring ſhort cylinders to which they are attached; and as theſe ſhort cylinders are 24 inches in diameter, while the tube is only 8 inches in diameter, the elaſticity of the large circular thin plates of metal will allow it to be preſſed inwards, or drawn outwards, without injury, much more than will be neceſſary in order to give room for the expanſions and contractions of the tubes.

Hence it appears, that by this ſimple contrivance, ſteam may be conveyed to any diſtance, however great, in cloſed metallic tubes, without any danger of injury to the tubes from the expanſions and contractions of the metal.

A ſhort deſcription of a contrivance which ſerves inſtead of ſafety-valves for a ſteam-apparatus which is uſed for heating the great Lecture Room at the houſe of the Royal Inſtitution.

The following figure, which repreſents a vertical ſection of this contrivance, will give a clear idea of it, and of the manner in which it acts.

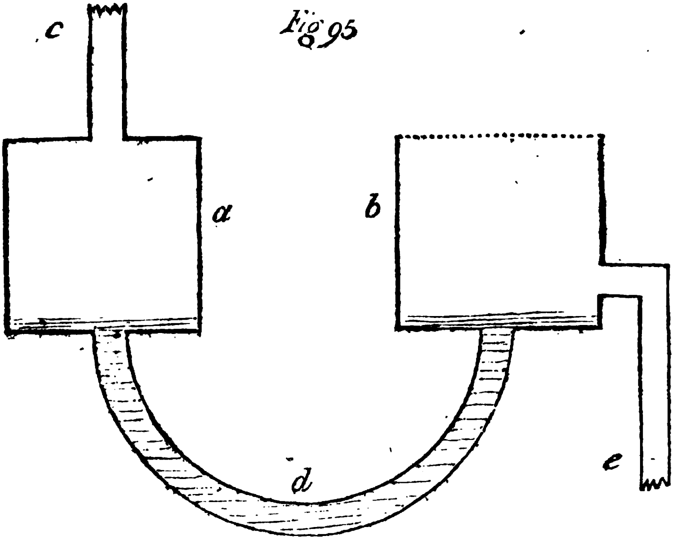


Fig 95

a, and *b*, are two cylinders of copper 6 inches in diameter, and 6 inches in length, placed in an erect poſition. The cylinder *a*, is cloſed both above and below;—the cylinder *b*, is cloſed below, but is open above.

The ſemi-circular tube *d*, which is repreſented filled with water, ſerves to connect the two cylinders together.

By the tube *e*, the water which reſults from the condenſation of the ſteam in the ſteam-tubes which warm the room, returns to the reſervoir which feeds the boiler. This water, after falling into the cylinder *a*, paſſes through the ſemi-circular tube *d*, into the cylinder *b*, and then goes off from that cylinder, and is conveyed, ſtill warm, to the reſervoir, by the tube *e*.

This ſimple apparatus ſerves as a ſafety-valve in the following manner: when the ſteam in the ſteam-tubes is redundant, it deſcends through the tube *c*, and forcing the water out of the ſemi-circular tube *d*, into the cylinder *b*, it follows it through that tube, and eſcapes into the open air through the open end of that cylinder. When the ſtrength of the ſteam is ſufficiently diminiſhed, a ſmall quantity of water, ſtill remaining in the lower part of the cylinder *b*, returns back into the tube *d*, and cuts off the communication between the external air and the inſide of the ſteam-tubes.

When, in conſequence of the fire under the boiler being extinguiſhed, or being much diminiſhed, a vacuum begins to be formed in the ſteam-tubes, the external air preſſing againſt the ſurface of the ſmall quantity of water remaining in the lower part of the cylinder *b*, forces it through the ſemi-circular tube *d*, into the cylinder *a*, and following it into that cylinder, opens for itſelf a paſſage into the ſteam-tubes, and prevents their being cruſhed by the preſſure of the atmoſphere, on the condenſation of the ſteam.

When the fire is gone out, and the whole apparatus becomes cold, the ſteam-tubes will be entirely filled with air.

When, on lighting the fire again, freſh ſteam is generated; as this ſteam enters the large ſteam-tubes in the *higheſt* or *moſt elevated* part of them, and as ſteam is ſpecifically lighter than atmoſpheric air, the ſteam remains above the air which ſtill occupies the ſteam-tubes, and accumulating there, preſſes this air downwards, and by degrees forces it out of the apparatus through the ſame paſſage by which it entered; the water in the ſemi-circular tube ſupplying the place of a valve,—or rather of two valves, in theſe different operations.

END OF THE TENTH ESSAY.

ESSAY XI.

SUPPLEMENTARY OBSERVATIONS

CONCERNING

CHIMNEY FIRE-PLACES.

CONTENTS OF THIS ESSAY.

Obſervations concerning Open CHIMNEY FIRE-PLACES.—*An account of various Faults that have been committed by workmen, in England, who have been employed in altering Chimney Fire-places, and fitting them up according to the Method recommended by the Author, in his Fourth Eſſay.—Conſequences which have reſulted from theſe Miſtakes.—Neceſſity of adhering ſtrictly, and without deviation, to the Directions which have been given.—Thoſe Particulars are pointed out in which Workmen are moſt liable to fail.*

ESSAY XI.

Of Chimney Fire-places.

I WAS much flattered on my return to England, in September 1798, after an abſence of two years, to find that the improvements in the conſtruction of chimney fire-places, which I had recommended in my Fourth Eſſay, publiſhed in London in the beginning of the year 1796, were coming into uſe in various parts of the country; and I have ſince taken a good deal of pains to find out how they have anſwered, and what faults and imperfections have been diſcovered in them: And as the information I have obtained by theſe inquiries has enabled me to make ſeveral remarks and obſervations relative to the conſtruction and management of theſe fire-places, that may be of uſe to thoſe who have introduced them, or may be deſirous of introducing them, I feel it to be my duty to lay them before the public.

It has been objected to theſe fire-places, that they ſometimes occaſion duſt and aſhes to come into the room when the fire is ſtirred. I have examined ſeveral fire-places ſaid to have been fitted up on my principles, that have certainly had that fault; but I have commonly, I might ſay invariably found, that their imperfections have ariſen from faults in their conſtruction. Either the grate has been brought out *too far* into the room, or the opening of the fire-place in front has been left too wide—or too high—or the workman has neglected to lower and to round off the breaſt of the chimney—or, what I have often found to be the caſe, ſeveral of theſe faults have exiſted together, in the ſame fire-place.

When the throat of a chimney is ſituated very high up above the mantle, and eſpecially when the mantle and breaſt of the chimney, or the wall that repoſes on the mantle, are very thin, workmen who are employed to alter chimnies, ſetting about the work with their minds ſtrongly prepoſſeſſed with what they conſider as the *leading principle* in the conſtruction of theſe fire-places, namely, that the throat of the chimney ſhould not be more than four inches wide, they are very apt to bring the grate too far forward. In dropping their plumb-line from the breaſt of the chimney, they do not reach up high enough into the chimney, but take a part of the breaſt, where it ſtill goes on to ſlope backwards, for the bottom of the perpendicular canal of the chimney. They alſo very often commit another fault, not leſs eſſential, and that has the ſame tendency, in neglecting to *bring down the throat of the chimney nearer to the fire*, when it happens to be ſituated too high.

This I have not only recommended in my Eſſay on Chimney Fire-places, but have given the moſt particular directions how it is to be done (ſee Eſſay IV. page 362), and to mark the importance of the object ſtill more ſtrongly, have accompanied thoſe directions by an engraving.

It is indeed a very important point, that the throat of the chimney ſhould be near the fire, and it ſhould always be carefully attended to. It is likewiſe very important to "*round off the breaſt of the chimney*;" though this I find is very often intirely neglected, even by workmen who have had much practice in the conſtruction of the fire-places I have recommended.

The breaſt of a chimney ſhould always be rounded off in the neateſt manner poſſible, beginning from the very front of the lower part of the mantle, and ending at the narroweſt part of the throat of the chimney, where the breaſt ends in the front part of the perpendicular canal of the chimney. If the under ſurface of the mantle is flat and wide, it will be impoſſible to round off the breaſt properly; and that circumſtance alone renders it indiſpenſably neceſſary, in thoſe caſes, to alter the mantle, or to run under it a thinner piece of ſtone, or a thin wall of bricks, ſupported on an iron bar, in order that the breaſt of the chimney may be brought to be of the proper form, and the throat of the chimney may be brought into its proper ſituation.

If the under ſide of the mantle be left broad and flat, it is eaſy to perceive that the cloud of duſt or light aſhes, that riſes from a coal fire nearly burnt out, when it is violently ſtirred about with a poker, ſtriking perpendicularly againſt this flat part of it, muſt unavoidably be beat back into the room; but when the breaſt of the chimney is properly rounded off, the aſcending cloud of duſt and ſmoke more eaſily finds its way into the throat of the chimney, and is even directed and aſſiſted in ſome meaſure by the warm air of the room that gets under the mantle, and is going the ſame way.

Another very common fault that I have obſerved in chimney fire-places, that have been altered on what have been called my principles, and which has a direct tendency to bring duſt, and even ſmoke, into the room, is the ſloping of the covings too much, and leaving the opening of the fire-place in front too wide. I have ſaid, in my Eſſay on Chimney Fire-places, that where chimnies are well conſtructed, and well ſituated, and have never been apt to ſmoke, in altering them the covings may be placed at an angle of 135 degrees with the back; but I have expreſsly ſaid that they ſhould never exceed that angle, and have ſtated at large the bad conſequences that muſt follow from making the opening of a fire-place very wide, when its depth is very ſhallow, (ſee page 338.) I have alſo expreſsly ſaid, (page 358) that for chimnies that are apt to ſmoke, the covings ſhould be placed *leſs obliquely*, in reſpect to the back, than in others that have not that fault. But moſt of the workmen who have altered chimnies, ſeem to have paid little attention to theſe diſtinctions, and I have frequently found, and ſometimes in fire-places that have been remarkably ſhallow, that the covings have been placed at an angle even more oblique than that above-mentioned.

Another cauſe that ſometimes has conſiderable effect in bringing duſt and ſmoke into rooms, from the fires that are made in them, is the great nicety with which the doors and windows are fitted in their frames, which prevents a ſufficient quantity of freſh air from coming into the room, to ſupply a briſk current up the chimney. It is however evident, that all the alterations in fire-places on the common conſtruction, that have been recommended in order to improve them, muſt tend directly and very powerfully to leſſen this evil; but nothing will ſo completely remedy it as lowering the mantle, and diminiſhing the width of the fire-place.

How many fire-places in cloſe rooms have been cured completely of throwing puffs of ſmoke and duſt into the room, merely by placing a regiſter-ſtove in them? But there is ſurely nothing peculiar to a regiſter-ſtove that could enable it to perform ſuch a cure, but merely as it ſerves to diminiſh the width and heighth of the opening of the fire-place; and how much eaſier could this be done with marble, or other ſtone, or with bricks and mortar, plaiſtered over and encruſted in front with proper ornaments in ſtucco, or in artificial ſtone?

I am the more anxious that ſomething of this ſort ſhould be introduced, as the openings of chimney fire-places are in general certainly too wide, and too high, and as I am convinced that there is no way of reducing them to a proper ſize, that would be ſo cheap, or more effectual, or tha could be made more ornamental.

Thoſe who are fond of the glitter of poliſhed ſteel, and have no objection to the expenſe of it, or to the labour that is required to keep it bright, may ſurround their fire-places *in front* with a border of it, for *there* it will do no harm, and may uſe grates and fenders of the moſt exquiſite workmanſhip; but if they wiſh to have a pleaſant, cheerful, and economical fire, the covings of their fire-places muſt be placed obliquely, and they muſt not be conſtructed of metal; and if the ſides and back of the grate be conſtructed of fire bricks inſtead of iron, the fire will burn ſtill brighter, and will ſend off conſiderably more radiant heat into the room.

I have abundant reaſon to think, that if in conſtructing or altering chimney fire-places, the rules laid down in my Eſſay on that ſubject are *ſtrictly* adhered to, chimnies ſo fitted up will very ſeldom be found either to ſmoke, or to throw out duſt into the room; and ſhould they be found to have either of theſe faults, there is a remedy for the evil, as effectual, as it is ſimple and obvious: *Bring down the mantle, and the throat of the chimney lower; and if it ſhould be found neceſſary, reduce the width of opening of the fire-place in front, and diminiſh the obliquity of the covings.*

Theſe alterations will certainly be effectual, to prevent either ſmoke or duſt from coming into the room *when there is a fire burning in the grate*; but it ſometimes happens, and indeed not unfrequently, that duſt and ſoot are drawn down a chimney in which there is no fire, to the great annoyance of thoſe who are in the room, and to the great damage of the furniture. When this happens, it is commonly occaſioned by a very ſtrong draught up *another chimney*, in which there *is a fire*, in an adjoining room, and when that is the caſe, the moſt ſimple remedy is to alter that other chimney, and conſtructing its fire-place on good principles, to reduce its throat to reaſonable dimenſions. But if the paſſage of the air down a chimney in which there is no fire, is occaſioned by ſtrong eddies of wind, there is no remedy for that evil but placing a chimney pot, of a peculiar conſtruction, on the top of the chimney, which ſhall counteract the effects of thoſe eddies, or by cloſing up the throat of the chimney occaſionally, by a door made for that purpoſe of ſheet iron.

If the door-way that is left in the back of the fire-place for giving a paſſage to the chimney ſweeper, inſtead of being cloſed with a tile, or with a flat piece of ſtone, ſet in a groove made to receive it, according to the directions given in my Fourth Eſſay, it be cloſed with a flat piece of caſt iron, or of plate iron, fixed at its lower end, to the lower end of the door-way, by a hinge, or moveable on two gudgeons; this plate may eaſily be ſo contrived as to ſerve occaſionally as a regiſter,

giſter, or door, for diminiſhing, or cloſing, the throat of the chimney.

As this plate, ſituated at the *back part* of the chimney, could not produce any of thoſe bad effects, that have with reaſon been attributed to the regiſters of common regiſter ſtoves, (which are placed on the breaſt of the chimney) it appears to me to be very probable, that it would be found uſeful as a regiſter for occaſionally altering the ſize of the throat of the chimney, and regulating its draught; as well as for occaſionally cloſing up that paſſage intirely. It would certainly be worth while to try the experiment.*

Before I quit this ſubject, I muſt mention another fault, which workmen employed in altering chimney fire-places, that are furniſhed with grates or ſtoves with ſloping backs, are very apt to make. They leave the back of the grate in its place, and inſtead of carrying up the back of the fire-place perpendicularly *from the bottom of the grate*, they firſt begin to carry it up perpendicularly from the top of the iron plate that forms the back of the grate; and as this plate not only ſlopes backwards conſiderably, but riſes ſeveral inches above the level of the upper bar of the grate, this neceſſarily throws the fire very far into the room. This tends to bring both ſmoke and duſt into the room, not only becauſe it brings the fire too far forward, but alſo becauſe it occaſions the air of the room, that ſlips in by the ſides of the covings, to get behind the current of ſmoke that riſes perpendicularly from the fire, which air frequently crowds the ſmoke forward, and cauſes it to ſtrike againſt the mantle. This is a great fault, and I am ſorry to ſay, that I have found it very common in many parts of England, where attempts have been made to introduce the fire-places I have recommended. Where grates *with ſloping backs* are uſed in fitting up theſe fire-places, theſe backs muſt either be taken quite away, or bricked up, and the new back part or back wall of the fire-place, muſt be made to ſerve as a back for the grate, againſt which the burning fuel is laid.

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* Since the introduction of the cottage and gridiron grates, this contrivance has come into very general uſe, and experience has ſhewn it to be extremely uſeful. I would ſtrongly recommend it to thoſe who fit up chimney fire-places on theſe principles, never to omit this regiſter; it coſts a mere trifle, and is very uſeful on many accounts.

As I am giving an account of the miſtakes that have been made by ſome of thoſe who have been employed in fitting up chimney fire-places on the principles I have publicly recommended, it will naturally be expected that I ſhould take ſome notice of thoſe numerous *improvements* that have been announced to the public, ſaid to have been made in ſtoves, grates, &c. to which advertiſers in the newſpapers have thought proper to affix my name. As I am extremely anxious not to injure any man, either in his reputation for ingenuity, or in his trade, or in any other way, I ſhall not ſay one word more on this ſubject, than what I feel it to be my duty to the public to declare, namely, that I am not the inventor of any of thoſe ſtoves or grates, that have been offered to the public for ſale, under my name.

Having mentioned the inconveniences that ſometimes ariſe from doors and windows being fitted to their frames with ſo much nicety, as not to give a ſufficient paſſage to air from without, to get into the room to ſupply the current up the chimney, which muſt always exiſt when a fire is burning in the room, I embrace this opportunity of mentioning a contrivance for remedying this defect, which I am perſuaded would not only be found moſt effectual for that purpoſe, but would at the ſame time contribute very eſſentially to rendering dwelling houſes more ſalubrious, and more comfortable, by facilitating the means of warming them more equally, and ventilating them more eaſily and more effectually.

In building a houſe an *air canal*, about twelve or fifteen inches ſquare, in the clear, and open at both ends, may be conſtructed, in, or near the center of each ſtack of chimneys; and two branches from this air canal, both furniſhed with regiſters, may open into each of the adjoining rooms; one of theſe branches opening into the fire-place, juſt under the grate, and the other over the fire-place, and near the top of the room, or juſt under the ceiling. Each of theſe branches ſhould be about four inches ſquare, in the clear; and to prevent the uncouth appearance of the open mouth of that which opens into the room over the fire-place, it may be maſked by a medallion, a picture, or any other piece of ornamental furniture proper for that uſe, placed before it at the diſtance of one or two inches from the ſide or wall of the room.

The bottom of this *air tube* ſhould reach to the ground, where it ſhould communicate freely with the open air of the atmoſphere, but it ſhould not riſe quite ſo high as the chimneys (or canals for carrying off the ſmoke) are carried up, but ſhould end (by lateral openings, communicating with the air of the atmoſphere) immediately above the roof of the houſe.

If this air tube be ſituated in the middle of a building, it is evident that an horizontal canal or tube of communication muſt be carried from its lower orifice to ſome open place without the building, in order to eſtabliſh a free circulation of freſh air, both upwards and downwards, in the *air tube.* I ſay both *upwards* and *downwards*, for ſometimes the current of air in the tube will be found to ſet upwards, and ſometimes downwards. Its direction will depend on the winds that happen to prevail, or rather on the eddies they occaſion in the air out of doors in the neighbourhood of the buildings, and it is no ſmall advantage that will ariſe from leaving both ends of the air-tube open, that the tube will always be ſupplied with a ſufficiency of air, whatever eddies the winds may occaſion. It is eaſy to perceive how powerfully this muſt operate,

rate, to prevent thoſe puffs of ſmoke which, in high winds, are frequently thrown into ſome rooms by the eddies, and the partial rarefactions of the air that they occaſion; but this is far from being the only or the moſt important of the advantages that will be derived from this air tube. Thoſe who conſider what an immenſe quantity of air is required to ſupply the current that ſets up the chimney of an open fire place, where there is a fire burning, muſt perceive what an enormous loſs of heat there muſt be, when all this expence of air is ſupplied by the warmed air of the room, and that all this warmed air is neceſſarily and conſtantly replaced by the cold air from without, which finds its way into the room, by the crevices of the doors and windows. But all this waſte of heat, or any part of it, at pleaſure, may be prevented by the ſcheme propoſed, for if the air neceſſary to the combuſtion of the fuel, and to the ſupplying of the current up the chimney, be furniſhed by the air-tube, the warmed air in the room will remain in its place; and as this will in a great meaſure prevent the cold currents from the crevices of the door and windows, the heat in the room will be the more equable, and conſequently the more wholeſome and agreeable on that account.

But there are, I am told, perſons in this country, who are ſo fond of ſeeing what is called a great roaring fire, that even with its attendant inconveniences, of roaſting and freezing oppoſite ſides of the body at the ſame time, they prefer it to the genial and equable warmth, which a ſmaller fire, properly managed, may be made to produce, even in an open chimney fire-place. To recommend the air-tubes to perſons of that deſcription, I would tell them, that by cloſing up, by means of its regiſter, the lower branch of communication (that which ends juſt under the grate) and ſetting that ſituated near the top of the room wide open, they may indulge themſelves with having a very large fire in the room *with little heat*, and this with much leſs inconvenience from currents of cold air from the doors and windows, than they now experience.

It is eaſy to perceive, that by a proper uſe of the two regiſters, together with a judicious management of the fire, the air in the room may either be made hotter, or colder;—or may be kept at any given temperature—or the room may be moſt effectually ventilated; and that this change of air may be effected, either gradually or more ſuddenly. And here it may perhaps be the proper place to obſerve, that in all our reaſonings and ſpeculations relative to the heating of rooms by means of open chimney fires, we muſt never forget that it is the *room that heats the air*, and not the air that heats the room.

The rays that are ſent off from the burning fuel, generate heat, only *when* and *where* they are *ſtopped*, or *abſorbed*, conſequently they generate no heat in the air in the room, in paſſing through it, becauſe they *paſs through it*, and are not *ſtopped* by it, but, ſtriking againſt the walls of the room, or againſt any ſolid body in the room, theſe rays are *there* ſtopped and abſorbed, and it is *there* that the heat found in the room is *generated.* The air in the room is afterwards heated by coming into contact with theſe ſolid bodies. Many capital miſtakes have ariſen from inattention to this moſt important fact.

It is really aſtoniſhing how little attention is paid to events which happen frequently, however intereſting they may be as objects of curious inveſtigation, or however they may be connected with the comforts and enjoyments of life. Things near us, and which are familiar to us, are ſeldom objects of our meditations. How few perſons are there who ever took the trouble to beſtow a thought on the ſubject in queſtion, though it is, in the higheſt degree, curious and intereſting.

END OF THE ELEVENTH ESSAY.

ESSAY XII.

OBSERVATIONS

CONCERNING THE

SALUBRITY OF WARM ROOMS

IN

COLD WEATHER.

CONTENTS OF THIS ESSAY.

Of the SALUBRITY *of* WARM ROOMS.—*A diſtinction ought to be made between* FRESH, or COLD AIR, *and* PURE, or WHOLESOME AIR.—*Streams of cold air are always pernicious.—They cannot be avoided in cold weather in rooms heated by a large open chimney fire.—The danger from theſe cold currents of air is greateſt when we are leaſt ſenſible of their exiſtence.—This remarkable fact is explained, by ſhewing that we are not capable of feeling heat and cold at the ſame time.—Sudden changes from hot rooms to the cold air is not dangerous to health.—This is proved by the healthfulneſs of the Swedes and Ruſſians, who inhabit very warm rooms in winter.—A warm room, by promoting a free circulation of the blood, gives that health and vigour which are neceſſary in order to ſupport without injury occaſional expoſure to intenſe cold.*

ESSAY XII.

Of the Salubrity of Warm Rooms.

IT is a queſtion often diſcuſſed in this country, whether living in a warm room in winter be, or be not, detrimental to health?

There is no doubt whatever of the neceſſity of *pure* air for the ſupport of life and health, but I really do believe that erroneous opinions are entertained by many people in this iſland, reſpecting the effects of that equal, and at the ſame time moderate heat, which can only be obtained in rooms where ſtrong currents of air up the chimney are not permitted. Thoſe who have been uſed to living in large apartments, in which the large fires that are kept up, inſtead of making the rooms equally warm, do little more than increaſe the violence of thoſe ſtreams of cold air, which come whiſtling in through every crevice of the doors and windows; when ſuch perſons come into a room in which an equal and genial warmth prevails in every part, ſtruck with the novelty of the ſenſation that this general warmth produces, they are very apt to fancy that the air is *cloſe*, and conſequently that it muſt be unwholeſome, and are uneaſy until a door or a window be opened, in order that they may get what they call *freſh* air.

But they do not ſeem to make a proper diſtinction between *freſh* air, and *pure* air. When they call for *freſh* air, they doubtleſs mean *purer* air. They certainly get *colder* air, but I much doubt whether they often get air that is more wholeſome to breathe; and it is moſt certain that the chilling ſtreams and eddies that are occaſioned in the room by the freſh air ſo introduced, are extremely dangerous, and often are the cauſe of the moſt fatal diſorders.

It is univerſally allowed to be very dangerous to be expoſed in a ſtream of cold air, eſpecially when ſtanding or ſitting ſtill;—but how much muſt the danger be increaſed if one ſide of the body be heated by the powerful rays from a large fire, while the other is chilled by theſe cold blaſts? And there is this ſingular circumſtance attending theſe chills, that they frequently produce their miſchievous effects without our being ſenſible of them; for as the mind is incapable of attending to more than one ſenſation at one and the ſame time, if the *intenſity* of the ſenſation produced by the heat on the one ſide of the body be ſuperior to that of the cold on the other, we ſhall remain perfectly inſenſible of the cold, however ſevere it may really be, and if we are induced by the diſagreeableneſs of what we do feel to turn about, or change our poſition or ſituation, this movement will be occaſioned, not by the cold, which we do not feel, but by the heat, which being ſuperior in its effect upon us, engages all our attention. And hence we may account for thoſe ſevere colds or catarrhs, which are ſo frequently gotten in hot rooms in this country by perſons who are not conſcious at the time of being expoſed to any cold, but, on the contrary, ſuffer great and continual inconvenience from the heat.

I have ſaid, that theſe colds are gotten in *hot rooms*, but it would have been more accurate to have ſaid *in rooms where there is a great fire*—or where there is a *great heat*, occaſioned by a great number of burning candles, or by a great number of perſons crowded together,—for it is very ſeldom indeed that A ROOM is much heated in this country, and their being cold is the principal cauſe which renders partial heats that occaſionally exiſt in them ſo very injurious to health.

The air of the room that comes into contact with the cold walls, and with the enormous windows, which, in open defiance of every principle of good taſte, have lately come into faſhion, is ſuddenly cooled, and being condenſed, and made ſpecifically heavier than it was before, in conſequence of this loſs of heat, it deſcends and forms cold ſtreams, that are ſo much the more rapid and more dangerous as the partial heats in the room are more intenſe,—conſequently they are the more dangerous, as they are leſs liable to be obſerved or felt.

If to theſe cold currents which are generated in the room, we add thoſe which come into it from without, to ſupply the enormous quantity of air that is continually going off by the chimney, when there is a great quantity of coals burning in an open grate, we ſhall not be ſurpriſed, that thoſe who venture to go into ſuch rooms without being well wrapped up in furs, or other warm cloathing, ſhould be liable to take colds.

I never ſee a delicate young lady dreſſed in thin muſlins, or gauzes, in the midſt of winter, expoſe herſelf in ſuch a perilous ſituation, without ſhuddering for the conſequences. But how many young perſons of both ſexes do we find, of delicate habits, and particularly among the higher ranks of ſociety?—And what vaſt numbers are carried off annually by conſumptions!

It is well known, that this dreadful diſorder is almoſt always brought on by colds, and that the cold of winter is commonly fatal to conſumptive people; but why ſhould the inhabitants of this iſland be ſo peculiarly ſubject to theſe colds? Is it not highly probably that it is becauſe they do not take proper care to prevent them?—For my part I declare, in the moſt ſerious manner, that I have not the ſmalleſt doubt that this is really the caſe.

Much has been ſaid of the ſuppoſed danger of keeping rooms warm in winter, on account of the neceſſity moſt people are under of ſometimes going into the cold air. But how many proofs are there, that theſe ſudden tranſitions from heat to cold, or from cold to heat, are not attended with danger, if care be taken to be properly cloathed, and if the heats and colds are not partial?

How very hot do the Swedes and the Ruſſians keep their houſes during the long and ſevere froſts that prevail in winter in thoſe countries? and yet no people are more ſtrong and healthy than they are, nor are there any leſs liable to catarrhs and conſumptions.

It is the very warm rooms in which this hardy race of men ſpend much of their time in winter, (which, by promoting a free circulation of their blood gives them health and ſtrength) that enables them to ſupport, without injury, expoſure, *for ſhort periods*, to the moſt intenſe cold.

In Germany, the rooms of people of rank and faſhion are commonly kept, in winter, at the temperature of about 64° or 65° of Fahrenheit's thermometer (the dwellings of the peaſants are kept much hotter); but though the ladies in that country are, from their infancy, brought up with the greateſt care, and are as little expoſed to hardſhips, as the women of condition in this, or in any other country, they find no inconvenience in going out of theſe warm rooms into the cold air. They even frequent the plays and the operas, and go on ſlaying parties, during the ſevereſt froſts, and ſpend one whole month in the depth of winter (in the ſeaſon of the carnival) in one continued round of balls and maſquerades. And, what may perhaps appear to many ſtill more incredible, they ſeldom fail, whatever the ſeverity of the weather may be, to ſpend half an hour every morning in a cold church.

But if in Germany, where the winters are incomparably more ſevere than they are in this country, perſons tenderly brought up, and of delicate habits, find no inconvenience whatever in living in warm rooms, and in going from them into the cold air, why ſhould warm rooms be unwholeſome in this country?

There cannot ſurely be any thing injurious to health in the genial warmth of 60° or 65°; and if *pure air* for reſpiration is what is wanted, the great height of our rooms in England ſecures us againſt all danger from that quarter.

The prejudice in this country againſt living in warm rooms in winter, has ariſen from a very natural cauſe; and though the prejudice is general, and very deeply rooted, as its cauſe is known to me, I really have hopes that I ſhall be able to combat it with ſome ſucceſs. I am perfectly ſure that juſtice will be done to the purity of my intentions in engaging in this arduous undertaking, and *that* I look upon as a circumſtance of no ſmall importance, eſpecially when I conſider that it can hardly eſcape the obſervation of my reader, that few perſons can be better qualified by their own experience, to give an opinion on any ſubject, than I happen to be to give mine on that under conſideration.

I went to Germany many years ago, with as ſtrong a prejudice againſt warm rooms as any body can have, but after having ſpent twelve winters in that country, I have learnt to know that warm rooms are very comfortable in cold weather, and that they certainly tend to the preſervation of health:

Having occupied a very large houſe, in which there are ſeveral apartments that are furniſhed with open chimney fire-places, I have had an excellent opportunity of making experiments of the comparative advantages and diſadvantages of warming rooms with them, and with ſtoves, and my opinions on theſe ſubjects have not been haſtily formed, but have been the reſult of much patient inveſtigation. They have been the reſult of conviction.

Were there any thing *new* in what I recommend, I might be ſuſpected of being influenced by a deſire to enhance the merit of my own diſcoveries or inventions; but as there is not, this ſuſpicion cannot exiſt; and I may fairly expect to be heard with that impartiality which the purity of my intentions give me a right to expect.

It may perhaps be aſked by ſome, what right I have to meddle at all in a buſineſs that does not concern me perſonally? Why not let the people of this country go on quietly in their own way, without tiring them with propoſals for introducing changes in their cuſtoms and manner of living, to which they evidently have a decided averſion ?

To ſuch queſtions and obſervations as theſe I ſhould make no reply, but ſhould ſtill feel anxious to promote, by every means in my power, all ſuch improvements as tend to increaſe the comforts and innocent enjoyments of life, from whatever quarter they might come.

If it be wiſdom to chooſe what is good, it muſt be folly to refuſe what is advantageous to us ;—and if liberality be an ornament to a reſpectable character, it is weakneſs to be aſhamed of adopting the uſeful inventions of our neighbours.

I am not without hopes, that, at ſome future period, houſes in England will become as celebrated for warmth and comfort, as they are now for neatneſs, and for the richneſs and elegance of their furniture.

However habit may have reconciled us to it, or rendered us inſenſible to its effects, *cold* is undoubtedly a very great phyſical evil. It may be, and no doubt is, productive of good in ſome way or other, but that is not a ſufficient reaſon why we ſhould not endeavour to guard ourſelves againſt its painful and diſagreeable effects. Their being painful is a proof of their being hurtful, and it is moreover a kind intimation to us of the preſence of an enemy, to be avoided.

We may, no doubt, by habit, inure ourſelves to cold in ſuch a manner as to render our bodies in ſome degree inſenſible to it ; but does it neceſſarily follow that by theſe means its pernicious effects on us are prevented, or even diminiſhed? I ſee no reaſon for ſuppoſing this to be the caſe.

If inuring to cold were a ſufficient preſervative againſt its bad effects, this method (which, certainly, would be the moſt economical) would, we have reaſon to think, have been adopted by Providence in reſpect to brute animals; but beaſts and birds which paſs the winter in cold climates, are all furniſhed with warm winter garments.

What provident nature furniſhes to brute animals, man is left to provide for himſelf, or to ſupply the want of it by his ingenuity.

If living in cold rooms really tended to give ſtrength and vigour to the conſtitution, and to enable men to ſupport without injury the piercing cold of winter, we might expect that the dwellings of the inhabitants of the Polar regions would be kept at a very low temperature; but this is ſo far from being the caſe in fact, that we always find the hotteſt rooms in the coldeſt climates.

If the tranſition from a hot room to the cold air were ſo dangerous as it is repreſented, how does it happen that Swedes and Laplanders, who live in rooms that are kept exceſſively hot, do not take cold when they expoſe themſelves to the intenſe cold of their winters?

Swedes and Ruſſians, who paſs the winter in England, never fail to complain of the uncomfortable coldneſs of our houſes, and ſeldom eſcape catarrhs, and other diſorders occaſioned by cold. And the ſickneſs and mortality which prevailed among the Ruſſian ſoldiers and ſailors, who wintered in this country in the years 1798 and 1799, were generally, and no doubt juſtly aſcribed to their being unable to ſupport the cold to which they were expoſed in our barracks, and in our hoſpitals; a degree of cold to which they never had been accuſtomed, *within doors*, and which to them appeared to be quite inſupportable.

Theſe are ſtrong facts; and the evidence they afford in the caſe under conſideration, is pointed, and appears to me to be incontrovertible. There are many other ſimilar facts that might be adduced in ſupport of the poſition we are endeavouring to eſtabliſh.

It has often been objected to warm rooms, that the air in them is always confined, and conſequently unwholeſome; but no argument more perfectly groundleſs and nugatory was ever adduced in ſupport of a bad cauſe.

When, in cold weather, a room is kept warm, the air in it, ſo far from being confined, is continually changing. Being ſpecifically lighter (in conſequence of its being warm) than the air without, it is impoſſible to open and ſhut a door without vaſt quantities of it being forced out of the room by the colder air from without, which ruſhes in; and if at any time it be required to ventilate the room in ſo complete a manner that not a particle of the air in it, ſhall remain in it, this may be done in leſs time than one minute, merely by letting down the top of one of the windows, and at the ſame time opening a door which will admit the external colder, and heavier air. And it muſt not be imagined that the room will be much cooled in conſequence of this complete ventilation.—So far from it, a perſon returning into it, three or four minutes after it had been ventilated, and the air in it totally changed, would not find its temperature ſenſibly altered.

The *walls of the room* would ſtill be nearly as warm as before, and the radiant heat from thoſe walls, paſſing through the tranſparent air of the room, without any ſenſible diminution of their calorific powers, would produce the ſame ſenſation of warmth as they did before. And even the cold air admitted into the room would in a few minutes become really warm. And as the ſpecific gravity of air is ſo very ſmall, compared with that of the denſe ſolid materials of which the walls, floor, and ceiling of the room are conſtructed, the warming of this air will not ſenſibly cool the room.

Hence we ſee how eaſy it is to ventilate warm rooms, in cold weather, and alſo how impoſſible it would be to live in ſuch a room, without the air in it being perpetually changed, and replaced with freſh and pure air from without.

It is thoſe who inhabit cold rooms who are expoſed to the danger of breathing confined air; for it would be in vain to open the doors and windows of ſuch an apartment; if the air in it is as cold, and conſequently juſt as heavy, as that without, there is no phyſical reaſon why it ſhould move out of its place. Part of it may indeed be blown out by a wind, or, without opening the doors and windows, a *part of it* may be forced up the chimney, if there be a fire burning in it; but this kind of ventilation is not only dangerous in a very high degree, to the health of thoſe who are in the room, but it is alſo partial, and very incomplete. As the currents of cold air which ſupply the draught of an open chimney fire are confined to the bottom of the room, below the level of the mantel of the fire-place, the ſame air may remain for weeks in the upper parts of the room, and perhaps for a much longer time in ſome remote corner, far from the fire.

I think enough has now been ſaid to prove to the ſatisfaction of every reaſonable perſon who is diſpoſed to liſten, and willing to be convinced, that the air in rooms properly and equally warmed in cold weather cannot be confined and contaminated;—and that inhabiting warm rooms in winter, ſo far from rendering perſons weak and unable to bear the cold on going abroad, is the beſt preſervative againſt the bad effects of occaſional expoſure to cold.

If there are any perſons who like cold rooms, and partial chilling ſtreams of cold air, and prefer them to the genial warmth of a mild and equal temperature, that choice muſt be conſidered as a matter of *taſte*, about which there is no diſputing.

There is a ſimple experiment, eaſily made, and no wiſe dangerous, which ſhews, in a ſenſible and convincing manner, that warmth prepares the body to bear occaſional cold without pain and without injury: let a perſon in health, riſing from a warm bed, after a good night's reſt, in cold weather, put on a dry warm ſhirt, and dreſſing himſelf merely in his drawers, ſtockings, and ſlippers; let him go into a room in which there is no fire, and walk leiſurely about the room for half an hour, or let him ſit down, and write or read during that time, he will find himſelf able to ſupport this trial without the ſmalleſt inconvenience; the cold to which he expoſes himſelf will hardly be felt; and no bad conſequences to his health will reſult from the experiment. Let him now repeat this experiment under different circumſtances. In the evening of a chilly day, and when he is ſhivering with cold, let him undreſs himſelf to his ſhirt, and ſee how long he will be able to ſupport expoſure to the air in a cold room in that light dreſs.

There is another remarkable fact, with which I was made acquainted by an eminent Phyſician of London, Dr. BLANE, which can hardly be accounted for but on a ſuppoſition that heat prepares and enables the body to ſupport cold. Thoſe perſons who, after having remained ſeveral years in the hot climates of India, return to reſide in this country, do not feel near ſo much inconvenience from the cold of our climate the firſt year after their return, as they do the ſecond.—If they would be perſuaded to live in warm rooms, *when they are within doors*; and make a free uſe of the warm bath, they *never* would feel any inconvenience from it; and they might with ſafety take much more exerciſe in the open air than they now do.

Occaſional expoſure to cold, when the body is prepared to ſupport it, ſo far from being dangerous, or injurious to health, is ſalubrious in a high degree.

It is in order that people may be enabled to go abroad frequently, and enjoy the fine bracing cold of winter, that I am ſo anxious that they ſhould inhabit warm comfortable rooms, when they are within doors. But if, during the time when they are ſitting ſtill, without exerciſe, the circulation of the blood is gradually and inſenſibly diminiſhed by the cold which ſurrounds them, and above all, by the cold currents of air in which they are expoſed, it is not poſſible that they ſhould be able to ſupport an additional degree of cold without ſinking under it.

They are like water, which, by long expoſure to moderate cold, in a ſtate of reſt, has been ſlowly cooled down below the freezing point; the ſmalleſt additional cold, or the ſmall agitation, changes it to ice in an inſtant; but water at a higher temperature, and full of latent heat, will ſupport the ſame degree of ſevere froſt, for a conſiderable time, without appearing to be at all affected by it.—The more attentively this compariſon is conſidered, the more juſt will it be found; and the more concluſive will be the inferences that are derived from it.

If man has been leſs kindly uſed than brute animals by being ſent naked into the world, without a garment to cover and defend from the inclemency of the ſeaſons, the power which has been given him over FIRE has made the moſt ample amends for that natural deficiency; and it would be wiſe in us to derive all poſſible advantages from the exerciſe of the high prerogative we enjoy.

END OF THE TWELFTH ESSAY.

ESSAY XIII.

OBSERVATIONS
CONCERNING THE
SALUBRITY OF WARM BATHING,
AND
THE PRINCIPLES
ON WHICH
WARM-BATHS
SHOULD BE CONSTRUCTED.

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The ſalubrity of warm bathing has been univerſally acknowledged in all ages.—It has been practiſed in all climates.—An account of a circumſtance by which the author was accidentally induced to turn his attention to this ſubject.—Good effects experienced by him from a very free uſe of the warm bath.—It is found that the uſe of the warm bath, ſo far from rendering perſons peculiarly liable to take cold on going into the cold air, actually ſtrengthens the conſtitution, and diminiſhes the danger attending occaſional expoſure to cold.—Excluſive of the ſalutary effects of warm bathing, the practice is well deſerving of being recommended on account of the delightful enjoyment which it affords.—Probability that the beſt method of fitting up and uſing warm baths is not known in this country.—Water in large quantities is not ſo neceſſary in a warm bath, as is generally ſuppoſed.—Probability that it is the warmth, and not the water, to which the ſalutary effects reſulting from warm bathing ought to be aſcribed.—Danger attending the uſe of tepid and temperate baths.—An account is given of the reſult of an intereſting experiment.—Great ingenuity diſplayed in the conſtruction of the hot baths of the Ruſſians.—A ſketch of a plan for an elegant bath.—Plan of a bath on a more economical ſcale.—Deſcription (from M. Savary) of the manner in which the warm bath is uſed in Egypt, and of the pleaſurable ſenſations which reſult from the uſe of it.

ESSAY XIII.

Of the Salubrity of Warm Bathing.

HAD I any hopes of being able, by any thing I could ſay, to prevail on the inhabitants of this iſland, to adopt more generally a practice which ſo many nations have conſidered as a moſt rational luxury, and which, no doubt, is as conducive to health, as it is eſſential to perſonal cleanlineſs, I ſhould think my time well employed were I to write a volume in recommendation of warm bathing: but I am ſenſible, that after all that has already been ſaid on that ſubject, by ancient and modern writers;—by hiſtorians, and by medical men;—what I could add would be of little avail. The ſubject is, however, ſo intimately connected with that treated in the preceding Eſſay (XII.) that I may, perhaps, without any impropriety, take the liberty to make a few obſervations concerning it.

If a perfectly free circulation of the blood, brought on and kept up for a certain time, without any violent muſcular exertion, and conſequently without any expence of ſtrength, be conducive to health, in that caſe warm bathing muſt be wholeſome; and ſo far from weakening the conſtitution, muſt tend very powerfully to ſtrengthen it.

Among

Among thoſe nations where warm bathing has been moſt generally practiſed, and where the effects of it have of courſe been beſt known, no doubts have ever been entertained of its being very beneficial to health; and nobody can doubt of its being pleaſant and agreeable in a high degree.

Had warm bathing never prevailed but in certain climates, doubts might be entertained of its *general* uſefulneſs; but ſo many nations,—remote from each other,—and inhabiting countries extremely different, not only in reſpect to climate, but alſo in reſpect to ſituation and produce, and where manners and cuſtoms have been extremely different in all other reſpects, have practiſed it,—that we may ſafely venture to pronounce warm bathing to be uſeful to man.

It was by accident I was led, about two years ago, to conſider this ſubject with that attention which it appears to me to deſerve; and I then made an experiment on myſelf, the reſult of which I really think very intereſting, and of ſufficient importance to deſerve being made known to the public.

The waters of Harrowgate, in Yorkſhire, having been recommended to me by my phyſician, I went there in the month of July 1800, and remained there two months. I began with drinking the waters, at the well, every morning, and with bathing in them, warmed to about 96° of Fahrenheit's thermometer, every third day, at my lodgings.

At firſt, I went into the bath at about ten o'clock in the evening, and remained in it from ten to fifteen minutes; and immediately on coming out of it, went to bed, my bed having been well warmed, with a view to preventing my *taking cold.*

Having purſued this method ſome time, and finding myſelf frequently feveriſh and reſtleſs after bathing, I accidentally, in converſation, mentioned the circumſtance to an intelligent gentleman, who happened to lodge in the houſe, and who had long been in a habit of viſiting Harrowgate every year. He adviſed me to change my hour of bathing; and to ſtay longer in the bath; and, above all, to avoid going into a warmed bed on coming out of it. I followed his advice, and ſhall have reaſon, all my life, to thank him for it.

I now went into the bath regularly every third day, about two hours before dinner, and ſtaid in it half an hour, and on coming out of it, inſtead of going into a warmed bed, I merely had myſelf wiped perfectly dry with warmed cloths, in a warmed room, adjoining to the bath; and dreſſing myſelf in a bed-gown, which was moderately warm, I retired to my room, where I remained till dinner time, amuſing myſelf with walking about the room, and with reading, or writing, till it was time to dreſs for dinner.

The good effects produced by this change of method were too ſtriking not to be remarked, and remembered. I was no longer troubled with any of thoſe feveriſh heats after bathing, which I experienced before; and ſo far from feeling *chilly*, or being particularly ſenſible to cold on coming out of the bath, I always found myſelf leſs ſenſible to cold after bathing than before. I even obſerved repeatedly and invariably, that the glow of health, and pleaſing flow of ſpirits, which reſulted from the full and free circulation of the blood, which bathing had brought on, continued for many hours; and never was followed by any thing like that diſtreſſing languor which always ſucceeds to an artificial increaſe of circulation, and momentary flow of ſpirits, which are produced by ſtimulating medicines.

I regularly found that I had a better appetite for my dinner on thoſe days when I bathed, than on thoſe when I did not bathe,—and alſo, that I had a better digeſtion, and better ſpirits; and was ſtronger to endure fatigue; and leſs ſenſible to cold in the afternoon and evening.

As theſe favourable reſults appeared to be quite regular and conſtant, I was induced to proceed to a more deciſive experiment. I now began to bathe every *ſecond day*; and finding that all the advantageous effects which I had before experienced from warm bathing ſtill continued, I was encouraged to go one ſtep further; and I now began to bathe *every day*.

This experiment was thought to be very hazardous, by many perſons at Harrowgate, and even by the phyſician, who did not much approve of my proceedings; but as no inconvenience of any kind appeared to reſult from it, and as I found myſelf growing ſtronger every day, and gaining freſh health, activity, and ſpirits, I continued the practice, and actually bathed *every day*, at two o'clock in the afternoon, for half an hour, in a bath at the temperature of 96° and 97 degrees of Fahrenheit's ſcale, during *thirty-five days*.

The ſalutary effects of this experiment were perfectly evident to all thoſe who were preſent and ſaw the progreſs of it, and the advantages I received from it have been permanent. The good ſtate of health, which I have ſince enjoyed, I aſcribe to it intirely.—But it is not merely on account of the advantages which I happened to derive from warm bathing, which renders me ſo warm an advocate for the practice.—Excluſive of the wholeſomeneſs of the warm bath, the luxury of bathing is ſo great, and the tranquil ſtate of mind and body which follows it, is ſo exquiſitely delightful, that I think it quite impoſſible to recommend it too ſtrongly, if we conſider it merely as a rational and elegant refinement.

I am perſuaded, however, that we are very far, in this country, from underſtanding the beſt method of fitting up warm baths, and of uſing them in the moſt comfortable and advantageous manner. It appears to me to be quite evident that it is not the water, but the *warmth* to which moſt, if not all the good effects experienced from warm bathing, ought to be aſcribed.

Among thoſe nations where warm bathing has been moſt generally practiſed, water has ſeldom beem employed, except occaſionally, and merely for waſhing and cleaning the ſkin: and though waſhing in warm water is pleaſant, and is, no doubt, very wholeſome; yet, remaining with the whole body, except the head, plunged and immerſed in that liquid for ſo great a length of time as is neceſſary, in order that a warm bath may produce its proper ſalutary effects, is not very agreeable, nor is it probably either neceſſary or ſalutary.

The manner in which a warm bath operates, in producing the pleaſant and ſalutary effects which are found to be derived from it, appears to me to be ſo evident as to admit of no doubt or difference of opinion on that ſubject.

The genial warmth which is applied to the ſkin, in the place of the cold air of the atmoſphere, by which we are commonly ſurrounded, expands all thoſe very ſmall veſſels where the extremities of the arteries and veins unite, and by gently ſtimulating the whole frame produces a free and full circulation, which, if continued for a certain time, removes all obſtructions in the vaſcular ſyſtem; and puts all the organs into that ſtate of regular, free, and full motion, which is eſſential to health, and alſo to that delightful repoſe, accompanied by a conſciouſneſs of the power of exertion, which conſtitutes the higheſt animal enjoyment of which we are capable.

If this ſtatement be accurate, it cannot be difficult to explain, in a manner perfectly ſatisfactory, why a warm bath is often found to produce effects when firſt uſed, and eſpecially by thoſe who ſtay in the bath for too ſhort a time, which are very different from thoſe which it ought to produce, and which it cannot fail to produce when properly managed. We ſhall likewiſe be enabled to account for the feveriſh ſymptoms, which reſult from going out of a warm bath into a warmed bed.

The beginning of that ſtrong circulation, which is occaſioned on firſt going into a warm bath, is an effort of nature to remove obſtructions; and if time be not given to her to complete her work, and if ſhe be checked in the midſt of it, the conſequences muſt neceſſarily be very different from thoſe which would reſult from a more ſcientific and prudent management. Hence we ſee how neceſſary it is to remain in a warm bath a ſufficient time; —and above all, how eſſential it is that the bath ſhould be *really warm*, and not tepid, or what has been called *temperate*.

When we conſider the rapidity with which water carries off heat from any body hotter than it, which is immerſed in it, we ſhall find reaſon for aſtoniſhment that any perſon, even the ſtrongeſt man in a ſtate of the higheſt health, is able to ſupport the loſs of heat which muſt neceſſarily reſult from lying for half an hour quite motionleſs in a tub of water, at the temperature of 55 or 60 degrees; and yet, if I am rightly informed, baths at that temperature have ſometimes been ordered by phyſicians, and even for perſons of delicate conſtitutions.

Becauſe we are able to ſupport that degree of cold, without injury, *in air*, that is very far indeed from being a good reaſon for concluding that *water* at that temperature would not be hurtful; for water is 800 times more denſe than air, and conſequently when it is cold, muſt deprive our bodies of heat, when we are immerſed in it, with infinitely greater rapidity than air, at the ſame temperature, can do.

Having reaſon to think that phyſicians in general are not ſufficiently aware of the very great difference there is in the powers of theſe two fluids to *carry off* heat when they are both at the ſame temperature;—and having myſelf been a witneſs, more than once, to very alarming conſequences which have reſulted from the uſe of what was called a *tepid bath*, I cannot reſiſt the inclination I feel to avail myſelf of this opportunity of calling the attention of medical men to a circumſtance which is, moſt undoubtedly, of very ſerious importance.

When we go into a bath at the temperature of about 96 degrees (which is blood heat) though the water at firſt may ſeem warm to us, and even hot, yet it is not capable of communicating much heat to us, for our bodies being at the ſame temperature, except it be perhaps at the very ſurface of the ſkin (where the nerves of feeling are moſt plentifully diſtributed) there is no reaſon why heat ſhould paſs out of the water into us; but if the water be only a few degrees below the temperature of the blood, though it may feel warm when we firſt go into the bath, yet that ſenſation will ſoon be followed by one of a very different nature; and the water will carry off heat very rapidly from the ſurface of the body.

A rapid cooling of the body, by carrying off, by a mechanical proceſs, the heat generated in the body by the action of the vital powers, may, or may not, be adviſeable in certain caſes. That is a queſtion of nice diſcrimination, and one upon which I am perfectly ſenſible that I am not qualified to decide: but I may be allowed to point out phyſical conſequences, not very obvious, and conſequently not likely to be ſubjects of meditation and inveſtigation, which ought certainly to be rightly underſtood.

There is one obſervation more reſpecting tepid and temperate baths, which appears to me to be deſerving of particular attention, and that is, the ſtate of *inaction* in which a perſon commonly remains in ſuch a bath, and the probable conſequences of inaction under ſuch circumſtances. Swimming is univerſally allowed to be an wholeſome exerciſe, and there are few inſtances, I believe, of harm ariſing from it, even when the water has been at a much lower temperature than that of the blood; but I am far from being of opinion that remaining in the water, without any muſcular exertion, would be found to be equally conducive to health.

Cold baths are perfectly different from hot baths, and tepid baths, and the intention of the phyſician in ordering them is alſo different. I am not prepared to explain the phyſical effects produced by a momentary plunge into cold water; and much leſs to give an opinion reſpecting the ſalubrity of the practice of cold bathing, or of its uſefulneſs as a remedy for certain diſeaſes.

But to return from theſe ſpeculations to more intereſting details—to the reſults of actual experiments.—During the thirty-five days that I continued to make daily uſe of a warm bath, I made a number of experiments on myſelf, in order fully to ſatisfy my own mind on ſeveral important points, reſpecting which I ſtill had doubts remaining. Some of thoſe experiments were certainly too hazardous to be reconciled to ſober good ſenſe, and to that prudent attention to the preſervation of health, which every wiſe man would be aſhamed of neglecting. But though I may be blameable for my temerity, and may even expoſe myſelf to ridicule by making a diſcovery of my raſhneſs; yet I am ſo deeply impreſſed with the importance of the reſults of ſome of my experiments, that I cannot refrain from laying them before the public.

Having long entertained an opinion, that the moſt effectual means that can be uſed to prepare the body to ſupport, without inconvenience, and without injury, thoſe occaſional expoſures to cold, to which every perſon is liable who inhabits a cold country, is, by a proper application of warmth, and without the fatigue of violent muſcular exertion, to bring on, and keep up for a certain time, at certain intervals, ſuch a full, ſtrong, and free circulation and perſpiration, as ſhall effectually remove, from time to time, all thoſe gradual contractions and obſtructions which chilling cold naturally produces, and give a new impulſe to thoſe actions in which life, health, and ſtrength conſiſt; I imagined that, if this opinion was well founded, the uſe of the warm bath, inſtead of rendering my habit more delicate, and making me more liable to take cold on expoſing myſelf in the cold air, I ſhould certainly find myſelf ſtrengthened by it, and my conſtitution rendered more robuſt.

The firſt direct proofs I had, that this advantageous change had actually taken place in me, were accidental; and it was probably that diſcovery which induced and encouraged me to expoſe myſelf voluntarily to more ſevere trials.

I had, from the time of my firſt arrival at Harrowgate, been in a habit of retiring to my room towards evening every day, where I commonly ſpent an hour or more in reading or writing, and as I never had any fire in my room, I frequently felt myſelf quite chilled by the cold of the evening. At this time I bathed only once in three days; but after I had begun to go into the bath before dinner, I ſoon found that I was much leſs ſenſible to the cold of the evening on thoſe days when I bathed, than on thoſe when I did not bathe.

It was the diſcovery of this intereſting fact which contributed much, and perhaps more than any thing elſe, to induce me to take the reſolution, (which was conſidered as very violent and unadviſed) of going into the bath every ſecond day, and afterwards every day.

After I had continued to bathe every day for ſome time, I no longer felt the ſmalleſt inconvenience from the cold of the evening, though I frequently ſat in my room with the windows open, when the weather was very cold and chilly, 'till it was ſo dark that I could neither ſee to read nor to write; and when I joined the company below, I felt myſelf in high ſpirits, and never wanted an excellent appetite to my ſupper. My ſleep was undiſturbed and refreſhing; and every thing indicated the return of perfect health.

All theſe favourable appearances having continued for ſome time, and finding my ſtrength to increaſe daily, I became more venturous, and frequently went out after it was dark, when the evening was cold and raw, and walked alone more than half an hour on the bleak dreary common, which lies before the houſe where I lodged (the Ganby Inn) to ſee if my conſtitution was really ſo much changed as to enable me to ſupport that trial without taking cold.

I even returned on foot from the play-houſe, acroſs the common, ſeveral times, in the evening, lightly dreſſed, when a cold wind blew over the common, and after I had ſuffered much from heat in the theatre: but in none of theſe ſevere trials did I receive the ſmalleſt injury: I never too cold, nor did I experience any feveriſh heats, or reſtleſſneſs, on going to bed after them. I call them *ſevere* trials, and as ſuch they will doubtleſs be conſidered, when it is recollected, that when I arrived at Harrogate, I was far from being in a good ſtate of health, (having never recovered from the dangerous illneſs I had brought on myſelf ſix or ſeven years before in Bavaria, by exceſſive application to public buſineſs) and when it is remembered that at the time when I was expoſing myſelf in this manner to the danger of taking cold, I was uſing the warm bath every day.

But I am firmly perſuaded that it was to the *warm bath*, that I was indebted for my eſcape; and it is that perſuaſion which has induced me to publiſh this account of my experiment.

I am very far indeed from wiſhing that my example ſhould be followed in all points.—All the unadviſed and imprudent details of the experiment may, and ought to be omitted. It would indeed be more than imprudent; it would be fooliſh to repeat them. But I do really believe that all thoſe who will be perſuaded to adopt the practice of warm bathing, in health and in ſickneſs, will find the greateſt and moſt permanent advantages from it.

Were the general and conſtant uſe of the warm bath, by perſons in health, a new thing, I ſhould have many ſcruples in recommending it to the public, whatever my private opinion of its ſalubrity might be. But ſo many nations have practiſed it for ages; and there are ſo many who now practiſe it, and—what is very remarkable—one (the Ruſſian) which inhabits the coldeſt parts of the globe, that there cannot poſſibly be the ſmalleſt reaſon to doubt of its beneficial effects.

With regard to the *pleaſant* effects that reſult from the uſe of the warm bath, there never has been any difference of opinion. But ſtill, I am quite certain that the true luxury of warm bathing is not underſtood in this country; and till the conſtruction of our baths is totally changed, and a different manner of uſing them adopted, we never can enjoy a warm bath as it ought to be enjoyed.

As we muſt allow, that in moſt caſes, and particularly in a matter of this kind, it is much more wiſe and prudent to adopt thoſe arrangements and improvements which have been the reſult of the experience of ages, than to ſet down and attempt to invent any thing new; I think we cannot do better than to rebuild ſome of the baths which were left us by the Romans. *They* moſt certainly underſtood warm bathing, as well as any nation ever did; and if there be any thing in our climate which renders any deviations neceſſary from the manner commonly practiſed in conſtructing baths in warmer countries, there is no doubt but thoſe luxurious foreigners, who had poſſeſſion of this iſland for ſo many years, muſt have found them out. The plans they have left us may therefore be adopted with ſafety as models for our imitation.

I am far from wiſhing to ſee the baths of Diocleſian and Caracalla riſe up, in all their ſplendour, in the neighbourhood of London, for I am well aware that the magnificent and oſtentatious exhibitions of a nation of conquerors, and ſlaves, would but ill accord with the manners of a free, enlightened, and induſtrious people; but ſtill I cannot help wiſhing that the inhabitants of this iſland, and all mankind, might enjoy all the innocent luxuries and comforts that are within their reach.

I am even jealous of the poor Ruſſian peaſant; and when I ſee him enjoying the higheſt degree of delight and ſatisfaction in the rude cave which he calls a warm bath—without wiſhing to diminiſh his pleaſure—I greatly lament that ſo uſeful and ſo delightful an enjoyment ſhould be totally unknown to ſo great a portion of the human ſpecies.

Who knows but that the poor Ruſſian, in the midſt of his ſnows—with his warm room, and warm bath—may not on the whole, enjoy quite as much happineſs as the inhabitant of any other country? And if this be really the caſe, what an addition would it be to the enjoyments of the inhabitants of other, more favoured countries, to add the warm room, and warm bath of the Ruſſian, to all their local advantages! When I meditate profoundly on theſe ſubjects, it is quite impoſſible for me not to feel my boſom warmed with the moſt enthuſiaſtic zeal for the diffuſion of that knowledge which contributes to the comforts and enjoyments of life.

There is nothing more intereſting than the reſults of the ingenuity of man in the infancy of ſociety, before the light of ſcience has extended his views, and increaſed the number of the objects of his purſuit. Ever intent upon a few ſimple mechanical contrivances, the uſefulneſs of which he continually experiences, all his thoughts remain concentrated on them, and all his ingenuity and addreſs are employed in rendering them perfect, and uſing them with agility and effect. When we examine the implements which ſavage nations have contrived to provide for themſelves, almoſt without tools, we ſhall ſee one of the moſt ſtriking proofs to be found, of the effects of perſevering induſtry, and long experience.

No perſon of any feeling can contemplate the canoes, ſnow-ſhoes, and hunting and fiſhing-tackle of the North American ſavages, without experiencing emotions which it would be very difficult to deſcribe: and the ingenuity diſplayed by the Ruſſian peaſant, in the conſtruction and management of his warm bath, is not leſs ſtriking.

Without any knowledge of the principles of pneumatics, hydroſtatics, and chemiſtry, he has proceeded in the ſame manner, preciſely, as he would have done, had he underſtood all thoſe ſciences; and without money, or the means of purchaſing any thing of value, he has contrived, with the rude materials, of no value, which he finds lying about him, to conſtruct an edifice in which he enjoys, in the moſt complete manner poſſible, all the delightful ſenſations which reſult from one of the moſt rational pleaſures, of the moſt refined and luxurious nations. And if ſecurity in the poſſeſſion of an advantage adds value to it, how much greater is the ſecurity of the Ruſſian peaſant in the enjoyment of his luxuries, than the rich and effeminate in the poſſeſſion of theirs?—Nothing is more calculated to fill us with wonder and admiration than to ſee how the different ſituations of man, on this globe, have been equalized by compenſations!

The warm baths of the Ruſſian peaſants have ſo often been deſcribed, that I dare not take up the reader's time unneceſſarily by given a particular account of them. They are, as is well known, what are called vapour baths; and as thoſe who build them are much too poor to afford the expence either of boilers, or bathing tubs, they are heated in a manner which is equally ingenious and economical. A parcel of ſtones are heated upon a wood fire made on the ground, and when theſe ſtones are hot, water or ſnow is thrown on them, and the ſteam which is produced, riſes up and occupies the inſide of the arched roof of the cave which conſtitutes the bath.

Thoſe who enjoy the bath, place themſelves, extended at full length, on a bed compoſed of the ſmall twigs and leaves of trees, on hurdles in the form of ſhelves, placed round the cave, under its vaulted roof, and above the level of the top of the door way.

From this ſhort deſcription it is evident, that the air occupying the top of the cave, and which is heated by the ſteam, being rendered ſpecifically lighter than the cold air without, by the heat it has acquired, will remain in its place, even though the entrance into the cave ſhould not be provided with a door. A few branches of trees placed againſt the door-way would break the force of the wind, if any were ſtirring, and the bath would remain as warm as ſhould be required, for any length of time, even in the moſt ſevere froſt of a Ruſſian winter, with the expence of a very ſmall quantity of fuel.

Were I aſked to give a plan for a warm bath, by a friend who had full confidence in my abilities to execute ſuch an undertaking with intelligence, I ſhould adopt, with little deviation, all the principles of the Ruſſian baths.

The bath room ſhould be built of bricks; and ſhould be covered above by a gothic or pointed dome; and the entrance into it ſhould not be through the ſide walls, but through the pavement, by a flight of ſteps from below. The walls ſhould be double, the inner wall being made as thin as poſſible, and the room ſhould be lighted by three or four very ſmall double windows of ſingle panes of glaſs ſituated juſt below the ſpring of the dome, which might be at the height of ſeven or eight feet above the pavement.

As the (double) walls of the building would be of ſome conſiderable thickneſs, and as the windows ought to be ſmall, and double, it would be very eaſy to conſtruct them in ſuch a manner that a perſon from without ſhould not be able to ſee any perſon in the bath, even though they were to get a ladder, and attempt to look in at the window. One of the windows ſhould be made to open, in order to ventilate the bath.

The inſide of the walls, and dome of the bath room ſhould be plaiſtered, and afterward well painted in oil;—or, (what would have a neater and more elegant appearance), they might be lined with Dutch tile.

The pavement might be made of any kind of flat ſtones, or of bricks, or tiles; or it might be conſtructed of ſtucco, well painted in oil, and it might be covered with matting.

If ornament were required, I would place a figure of Veſta, holding an Argand's lamp, on a pedeſtal, on one ſide of the room. This pedeſtal, which ſhould be large in proportion to the figure, ſhould be made of ſheet copper, and painted of a bronze colour on the outſide. The cavity within it ſhould be accurately cloſed on every ſide, in order that it might occaſionally be filled with ſteam from a boiler ſituated without, and uſed as a ſtove for warming the room.

The important object had in view in making the entrance into this bath from below (the preſervation of the warm air in the room) might be attained equally well with the door placed on one ſide of the room, provided the door were made to open immediately into a narrow deſcending vaulted gallery, furniſhed with a good door at the lower end of it.

The top of the door at the lower end of this gallery ſhould be two or three feet below the level of the bottom of the door at the top of it, which opens into the bath.

By ſetting both theſe doors open; and at the ſame time opening one of the windows of the bath, all the warm air in it, below the level of the window, will be forced out, in a very few moments, and the room will be completely ventilated.

If the entrance be made through the ſide of the room, in the manner juſt deſcribed, this will render the form of the room more ſimple, and more elegant, than if the paſſage into it were from below, through the pavement.

If the pavement of the bath be on a level, or nearly on a level, with the ſurface of the ground, the entrance into it muſt, nevertheleſs, come from a lower place. If the door leading into the bath be ſituated at one ſide of the room, the vaulted gallery, with which it communicates, muſt deſcend below the level of the ſurface of the ground, and a paſſage muſt be opened from without, in order to arrive at the door which muſt cloſe this gallery at its lower extremity.

A ſteam boiler ſhould be placed under the bath, in a vaulted room, and the ſmoke from the cloſed fire-place of the boiler ſhould be made to circulate in flues under the pavement of the bath, near the walls of the room, in which part the pavement ſhould not be covered with matting.

A bathing tub ſhould ſtand on one ſide of the room, and oppoſite to it ſhould be placed a bamboo or caned ſopha, covered, firſt with a ſoft thick blanket, and then with a clean ſheet, thrown over it.

The bathing tub, which might be of the uſual dimenſions, ſhould be placed on a platform of wood, covered with ſheet lead, about ſeven or eight feet ſquare, and raiſed ſix or ſeven inches above the pavement. This platform ſhould be flat, and nearly horizontal, with a border all round it, about two or three inches high, and a leaden pipe at the loweſt part of it, to carry off the water that happens to fall on it.

The lead ſhould be covered by thin boards, or by a looſe piece of matting; and a caned chair, or a ſtool, ſhould be placed on the platform, by the ſide of the bathing tub. A pipe ſhould be prepared for admitting cold water into the bathing tub from a reſervoir ſituated without the bath; and another for bringing ſteam into it, to heat it, from the ſteam boiler. There ſhould likewiſe be a waſte pipe for carrying off the water when the bathing tub is emptied.

The bathing tub ſhould not be ſet down immediately upon the lead which covers the platform on which the tub is placed, but ſhould be raiſed eight or ten inches above it, in order that the air may paſs freely under the bottom of the tub; and that there may be room to come at the lead, to waſh it, and clean it, in every part.

A bath conſtructed in the manner here deſcribed might be kept conſtantly warm, all the year round, at a very ſmall expence for fuel; and in that caſe, it would always be ready for uſe.

It is equally well calculated to ſerve as a warm air-bath;—as a vapour-bath;—or as a warm water-bath;—and when it is uſed as a water-bath, the air in the room may be made either warm, or temperate, at pleaſure.

This laſt circumſtance I take to be a matter of the greateſt importance; for nothing ſurely can be more diſagreeable than the ſenſations of a perſon on getting out of a tub of warm water, and ſtanding ſhivering with cold, till he is wiped dry, and dreſſed; and I cannot help ſuſpecting, that ſuch a ſituation is as dangerous as it is unpleaſant.

I am much inclined to think that the warm *air-bath*, with occaſional waſhing with warm water, will be found to be not only the moſt pleaſant, but alſo the moſt wholeſome of any; and if that ſhould be the caſe, no building could anſwer for that purpoſe in this country—(where the temperature of the atmoſphere is always ſo much below that which would be wanted) unleſs it were conſtructed on principles ſimilar to thoſe, on which the plan above deſcribed is founded.

Hot air may at any time be procured in any climate, but a large maſs of air moderately and *equally* warm cannot be *preſerved* in a cold country, by any other means than by preventing its being cooled, and preventing its being driven away by the denſer ſurrounding medium.

The double walls, and ſmall double windows of the bath, which I have recommended, will prevent the *cooling* of the air in it; and the form of the room renders it abſolutely impoſſible for the cold air of the atmoſphere, either to mix with that warm air, or to *force it out of its place*.

If it be required to mix ſteam with the air of the room to render it moiſt, that may be done by laying a ſteam tube for that purpoſe from the boiler, into the room; or it may be done in a manner ſtill more refined and luxurious, by having a ſmall portable boiler for that purpoſe, heated by a ſpirit lamp, or a common tea urn, heated, or rather kept boiling, by an iron heater; or a common tea-kettle heated by a ſpirit lamp, might be made uſe of. The water might be brought in, already boiling hot, and if a quantity of cloves, or other ſpices were mixed with it, the room would be filled with the moſt grateful, and moſt ſalutary perfumes. By burning ſweet ſcented woods or aromatic gums and reſins in the room, in a ſmall chafing diſh filled with live coals, the air in the room would be perfumed with the moſt pleaſant aromatic odours.

Thoſe who are diſpoſed to ſmile at this diſplay of eaſtern luxury, would do well to reflect on the ſums they expend on what *they* conſider as luxuries; and then compare the real and *harmleſs* enjoyments derived from them, with the rational and innocent pleaſures here recommended. I would aſk them, if a ſtateſman, or a ſoldier, going from the refreſhing enjoyment of a bath ſuch as I have deſcribed, to the ſenate or to the field, would, in their opinion, be leſs likely to do his duty, than a perſon whoſe head is filled, and whoſe faculties are deranged, by the fumes of wine.

Effeminacy is no doubt very deſpicable, eſpecially in a perſon who aſpires to the character and virtues of a man; but I ſee no cauſe for calling any-thing *effeminate*, which has no tendency to diminiſh either the ſtrength of the body;—the dignity of ſentiment;—or the energy of the mind. I ſee no good reaſon for conſidering thoſe grateful aromatic perfumes, which in all ages have been held in ſuch high eſtimation, as a leſs elegant, or leſs rational luxury than ſmoaking tobacco; or ſtuffing the noſe with ſnuff.

Having given a ſlight ſketch of a bath on a ſcale of magnificence and refinement, which will not ſuit every perſon's circumſtance; and may not accord with every perſon's taſte, I will now give another on a leſs expenſive, and more modeſt plan.

Let a ſmall building be erected, 14 feet 5 inches long, and 9 feet wide, meaſured within, and 7 feet high; and let it be divided into equal rooms of 9 feet long, and 7 feet wide each, by a partition wall of brick 4½ wide, or equal in thickneſs to the width of a brick. Let the outſide walls of this little edifice be double, the two walls being each the width of brick in thickneſs, and the void ſpace between them, being likewiſe of the ſame thickneſs, viz. about 4½ inches. In order to ſtrengthen theſe double walls, they may be braced and ſupported one againſt the other, by uniting them, in different parts, by ſingle bricks, laid acroſs, with their two ends fixed in the two walls.

Inſtead of a floor of boards, theſe two little rooms ſhould be paved with 12 inch tiles, or flat ſtones, laid in ſuch a manner, on thin parallel walls, (4½ inches in thickneſs) as to form horizontal flues under every part of the pavement.

There ſhould be no door of communication between theſe rooms, but each ſhould have its ſeparate entrance from without, by a door opening directly into a ſeparate narrow deſcending covered gallery. Theſe two doors ſhould be placed on the ſame ſide of the building, and their two ſeparate deſcending galleries may be parallel to each other, and may indeed be covered by the ſame roof.

They may together, form one gallery, divided into two narrow paſſages by a thin partition wall, conſtructed with bricks.

A ſmall porch at the bottom of the gallery ſhould be common to both paſſages, but each paſſage ſhould, nevertheleſs, have its ſeparate door, at its lower extremity, where it communicates with the porch.

The top of the door-way of this deſcending paſſage, at its lower extremity, muſt be at leaſt one foot below the level of the pavement of the rooms.

This paſſage may be furniſhed with a flight of ſteps; or its deſcent may be made ſo eaſy as to render ſteps unneceſſary.

If there ſhould be no natural elevation of ground at hand, on which this bath can conveniently be ſituated, a mound of earth muſt be raiſed for that purpoſe; otherwiſe it will be neceſſary that the porch at the end of the gallery ſhould be ſituated 7 or 8 feet below the ſurface of the ground; for it is indiſpenſably neceſſary that the entrance into the bath ſhould be by an *aſcent*, and in a *covered gallery.**

The building may be covered with a thick thatched roof, which will, on ſome accounts, be better than any other; but any other kind of roof will anſwer very well, provided it be tight; and that a quantity of ſtraw, or of chaff, or of dry leaves be laid over the ceiling of the two ſmall rooms, under the roof, to confine the heat. The ceiling of the rooms ſhould be lathed and plaiſtered, and the walls of the room ſhould be plaiſtered and white-waſhed.

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* If the entrance into the houſes of poor cottagers were conſtructed on the ſame principles, this ſimple contrivance would ſave them more than half their expences for fuel, in cold weather.

At the end of one of the rooms oppoſite to the door, a bathing tub ſhould be placed; and in the other a caned ſofa.

The bathing tub ſhould be placed on a platform 7 feet ſquare, covered with ſheet-lead, and raiſed about nine inches above the level of the pavement. This platform ſhould have a rim all round it, and a pipe for carrying off out of the room, the water that accidentally falls on it.

The bathing tub ſhould be ſupplied with cold water from a reſervoir (a common caſk will anſwer perfectly well for that uſe) which ſhould ſtand without the houſe.

The water ſhould be admitted cold into the bathing tub, and ſhould be warmed in it, by means of ſteam, which may come from a ſmall ſteam-boiler, which ſhould be ſituated without the building, and near to the reſervoir of cold water. A ſmall open ſhed, made againſt one ſide of the building—that ſide of it which is oppoſite to the entrance gallery—may cover both the boiler and the reſervoir. The boiler, which need not be made to contain more than ſix or eight gallons, ſhould be well ſet in brick-work, and well covered over with bricks, to prevent the loſs of heat which would reſult from any part of the boiler being expoſed naked to the cold air of the atmoſphere.

This boiler ſhould be ſo fitted up, by means of a ball-cock, as to feed itſelf regularly with water from the neighbouring reſervoir.

The boiler ſhould be furniſhed with a ſafety valve, opening into the open air, and with a tube for conveying ſteam into the bathing-tub. This tube, which may be a common leaden pipe, about half an inch in diameter, ſhould be wound round with the liſt of coarſe cloth, or with any warm covering of that ſort, to confine the heat.

This ſteam tube ſhould riſe up perpendicularly from the boiler to the height of eight or ten inches above the level of the ceiling of the bath-room, and ſhould then be bent towards the building, aud made to enter the roof of it, and then to deſcend perpendicularly through the ceiling of the bath-room, and enter the bathing-tub. Its open end ſhould reach to within an inch of the bottom of the tub, and a little above the level of the top of the tub there ſhould be a ſteam-cock, by means of which the paſſage of the ſteam through the ſteam-tube, and into the water in the bathing-tub, may be regulated, or prevented entirely, as the occaſion may require.

There may be a ſhort branch, ſix or eight inches long, inſerted into the ſteam-tube juſt deſcribed, which branch will ſerve for admitting ſteam into the room when it is deſigned to be uſed as a ſteam, or vapour-bath.—This ſhort branch muſt of courſe be furniſhed with its own ſeparate ſteam-cock.

The ſmoke from the (cloſed) fire-place of the boiler muſt be made to circulate under the pavement of the two rooms of the bath, in the flues conſtructed for that purpoſe, before it is ſuffered to paſs off into the chimney.

The chimney ſhould ſtand on the outſide of the building, and be made to lean againſt, and be ſupported by the wall of the building. There ſhould be a damper in this chimney.

Each of the ſmall rooms ſhould be furniſhed with a ſmall double window; each window conſiſting of one large pane of glaſs, and being made to open by means of a hinge, placed on one ſide of it.

Theſe windows ſhould be placed as near the ceiling of the room as poſſible, in order to facilitate the perfect and ſpeedy ventilation of the bath. The inſide windows may be placed level with the inſide of the wall of the houſe; and the outſide window level, or fluſh, with the outſide wall. Either the inſide windows or the outſide windows ſhould be made of ground or of wavy glaſs, in order that a perſon in the bath may not be expoſed to being ſeen through the windows.

The two ſmall rooms may be diſtinguiſhed by calling one of them the *bath-room*, and the other the *dreſſing-room*.

If it be required to heat the two rooms in a very ſhort time, the one with vapour, and the other with dry air, equally warmed, and perfectly free from all diſagreeable ſmells, this may be done by the following ſimple contrivance. Let a cylinder of very thin copper, about eight inches in diameter, and five feet in length, be placed horizontally under the ſopha in the dreſſing-room, and let a ſteam-pipe from the boiler be laid into it, with another pipe for carrying off the water reſulting from the condenſation of the ſteam in it. By admitting ſteam into this tube, the air in the room will ſoon be warmed, without any watery vapour being mixed with it;—and by admitting ſteam into the bath-room, and allowing it to mix with the air of that room, a vapour-bath will be formed, and in a very few minutes will be ready for uſe.

A ſmall quantity of cold water may then be admitted into the bathing-tub, and the ſteam being turned into it, it will ſoon be made warm enough to be uſed for waſhing, after the ſteam-bath has been uſed.

The paſſage from the bath-room into the dreſſing-room will be attended with no danger from cold; and it will be found very pleaſant to dreſs and repoſe in a warm room, where the air is pure, and not charged with vapour, after coming out of the water, or out of a vapour-bath.

If there ſhould be any apprehenſion that either the bath-room, or the dreſſing-room, might be too much heated by the ſmoke from the boiler paſſing continually through the flues under the pavement, a canal, furniſhed with a damper, leading from the cloſed fire-place of the boiler immediately into the chimney, might be made; and whenever the pavement ſhould become too hot, by opening this canal the ſmoke would paſs off immediately into the chimney by the ſhorteſt road, and the pavement would receive no more heat from it. I think it would in all caſes be adviſable to take this precaution, in conſtructing a bath on the principles here recommended.

But I muſt haſten to finiſh this long diſſertation; and I ſhall conclude it with a few paſſages from a modern traveller (M. SAVARY) who may be conſidered as being well qualified to give an opinion on the ſubject in queſtion.

Speaking of the manner of uſing the warm bath in Egypt, he ſays, "The bathers here are not "imprisoned, as they are in Europe, in a kind of "tub, where one is never at one's eaſe. Extended "on a cloth ſpread out, with the head ſupported "by a ſmall cuſhion, they can ſtretch themſelves "freely in every poſture, whilſt they lie quite at "their eaſe, envelloped in a cloud of odoriferous "vapours, which penetrates all their pores. In "this ſituation they repoſe for ſome time, till a "gentle moiſture upon the ſkin appears, and by "degrees diffuſes itſelf over the whole body. A "ſervant then comes and *maſſes* them (as it is "called, from a word in the Arabic language, "which ſignifies *to touch in a delicate manner.*) He

" ſeems to knead the fleſh, but without cauſing
" the ſmalleſt pain; and when that operation is
" ended, he puts on a glove, made of woollen ſtuff,
" and rubs the ſkin for a conſiderable time.

" During the whole of this time the ſweat con-
" tinues to be moſt profuſe; and a conſiderable
" quantity of ſcaly matter, and other impurities,
" which obſtructed the pores of the ſkin, are re-
" moved, and the ſkin becomes quite ſoft, and as
" ſmooth as ſatin.

" When this operation is ended, the bather is
" conducted into a cloſet, in which there is a ciſ-
" tern, ſupplied with hot, and with cold water,
" which comes into it through two ſeparate pipes,
" each furniſhed with a braſs cock. Here a lather
" of perfumed ſoap is poured over him.

" After being well waſhed and wiped, a warm
" ſheet is wrapped round him, and he follows the
" attendant through a long winding paſſage into
" an external and more ſpacious apartment. This
" tranſition from heat to cold produces no diſ-
" agreeable ſenſations, nor any bad conſequences.

" In this airy apartment a bed of repoſe is found
" prepared, and freſh and dry linen is brought.
" A pipe is alſo brought, and coffee is ſerved.

" Coming out of a hot bath, where one was
" ſurrounded by a cloud of warm vapours till the
" ſweat guſhed from every pore, and being tranſ-
" ported into the free air of a ſpacious apartment,
" the breaſt dilates, and one breathes with volup-
" tuouſneſs. The pores of the body being per-

" fectly cleaned, and all obſtructions removed, one " feels as it were regenerated; and one experiences " an univerſal comfort. The blood circulates with " freedom, and one feels as if diſengaged from an " enormous weight, with a ſenſe of ſupleneſs and " lightneſs, which is as new as it is delightful. A " lively ſentiment of exiſtence diffuſes itſelf over " the whole frame, and the ſoul, ſympathizing in " theſe delicate ſenſations, enjoys the moſt agree- " able ideas. The imagination, wandering over the " univerſe, which it embelliſhes, ſees on every ſide " the moſt enchanting pictures—every where the " image of happineſs!

" If the ſucceſſion of our ideas be the real mea- " ſure of life, the rapidity with which they then " recur to the memory, and the vigour with which " the mind runs over the extended chain of them, " would induce a belief, that in the two hours of " delicious calm that ſucceeds the bath, one has " lived a number of years!"

END OF THE THIRTEENTH ESSAY.

ESSAY XIV.

SUPPLEMENTARY OBSERVATIONS

RELATING TO

THE MANAGEMENT

OF

FIRES IN CLOSED FIRE-PLACES.

CONTENTS OF THIS ESSAY.

Neceſſity of keeping the doors of cloſed Fire-places well cloſed; and of regulating the air that is admitted into them.—Account of ſome experiments, which ſhewed, in a ſtriking manner, the very great importance of thoſe precautions.—A method is propoſed for preventing the paſſage of cold air into the large fire-places of Brewhouſe Boilers, Diſtillers Coppers, Steam-Engine Boilers, &c. while they are feeding with coals.—Bad conſequences which reſult from overloading cloſed Fire-places with fuel.—Computations, which ſhew, in a ſtriking manner, the vaſt advantages that that will be derived from the uſe of proper care and attention in the management of fire, and in the direction and economy of the heat which reſults from the combuſtion of fuel.

ESSAY XIV.

Of the Management of Fires in cloſed Fire-places.

THOUGH I have already mentioned, more than once, the neceſſity of preventing the entrance of air into a cloſed fire-place, by any other paſſage than by the regiſter of the aſh-pit door, and have ſtrongly recommended the keeping of the door of the fire-place conſtantly cloſed; yet, as I have ſince found that thoſe precautions are even of more importance than I had imagined, I conceived that it might be uſeful to mention the ſubject again, and give an account of the ſeries of experiments, from the reſults of which I have acquired new light in reſpect to it.

In fitting up a large ſhallow circular kitchen boiler (one of thoſe I put up in the kitchen of the houſe formerly occupied by the Board of Agriculture) I made an experiment, which, though it appeared to me at the time to have ſucceeded perfectly, led me into an error, that afterwards cauſed me a great deal of embarraſſment. I conſtructed the fire-place of the boiler, of a peculiar form, for the expreſs purpoſe of *burning the ſmoke*; imagining, that if I could ſucceed in that attempt, I ſhould not only get more heat from any given quantity of coals, but alſo, that the narrow horizontal canal that carried off the ſmoke from the fire-place to the chimney, would be much leſs liable to be choaked up by ſoot or duſt. The fire-place was made rather longer than uſual; and near the farther end of it there was a thin piece of fire-ſtone, placed edge-wiſe, which run quite acroſs it, from ſide to ſide, a ſpace being left about 2 ½ inches wide, between the lower edge of this ſtone and the bars of the grate, while the bottom of the boiler repoſed on its upper edge.

From this deſcription it is evident, that the flame of the burning fuel, after riſing up and ſtriking againſt that part of the bottom of the boiler which was ſituated over the hither part of the fire-place, muſt neceſſarily paſs under the lower edge of the ſtone juſt mentioned, in order to get into the canal leading to the chimney; and I fancied, that by taking care to keep that *narrow paſſage* conſtantly occupied by red-hot coals, the ſmoke, being forced to paſs through between them, would neceſſarily take fire, and burn. This actually happened; and when I left a ſmall opening in the door of the fire-place, to give admittance to a little freſh air to facilitate and excite the combuſtion, the flame became ſo exceedingly vivid and clear, that I promiſed myſelf great advantages from this new arrangement.

Being ſoon after engaged in putting up a large ſquare boiler in the kitchen of the Foundling Hoſpital, I there introduced the ſame contrivance;—but how great was my ſurprize on finding, that notwithſtanding the extreme vivacity of the fire, the contents of the boiler could not be brought to boil in leſs time than five hours! The fire-place, it is true, was ſmall, and the brick-work was new and wet; but I found that the quantity of coals conſumed was ſuch, that had there been no eſſential fault in the conſtruction of the fire-place, nor in the management of the fire, the contents of the boiler ought, notwithſtanding theſe unfavourable circumſtances, to have boiled in leſs than one-third part of the time that had been found neceſſary to bring it into a ſtate of ebullition.

Having waſted two or three days in attempting to remedy the defects of this fire-place, without changing entirely the principles of its conſtruction;—concealing my diſappointment from thoſe who it was neceſſary ſhould have confidence in my ſkill, by repreſenting to them all that had been done as being a mere experiment, I pulled down the work to the foundation, and cauſed it to be rebuilt on principles which I knew could not fail to ſucceed, and which did ſucceed to the utmoſt of my expectations.

Though I ruminated often on this diſappointment, I did not find out the real cauſe of my ill ſucceſs for ſome months. This diſcovery was, however, at length made, and in ſuch a manner as to leave no room for doubt.

Having, as an experiment, conſtructed in the kitchen of the Military Academy at Munich, an apparatus for the performance of all the different proceſſes of cookery, and to ſerve occaſionally for warming a room, with one and the ſame fire, thinking that the principles of the invention might be employed with advantage in the conſtruction of cottage fire-places, on my return to this country I made the experiment at my lodgings in Brompton-row, Knightſbridge; and, deſirous of accommodating the contrivance to what I think may be called a prejudice of Engliſhmen, I contrived the machinery in ſuch a manner as to render the fire *viſible.*

A ſmall low grate was fixed in the middle of a large open kitchen fire-place, and on each ſide of it were fixed in brick-work two Dutch ovens, one above the other; the bottom of the lower oven, on each ſide, being nearly on a level with the top of the grate; and as each of the ovens was ſurrounded by flues, I had hopes, that by cauſing the flame and ſmoke of the open fire to incline downwards, and enter an horizontal canal, ſituated juſt behind the fire, and there to ſeparate to the right and left, and circulate under the iron bottoms of the ovens, they would, by that means, be ſufficiently heated to bake or to boil; and even if the two upper ovens ſhould not be found to be ſufficiently heated to perform thoſe proceſſes of cookery, I thought, by leaving their doors open, they might at leaſt be very uſeful, occaſionally, for warming the room, acting in the manner of a German ſtove: but the experiment was far from ſucceeding as I expected.

The current of flame and ſmoke which aroſe from the open fire, was, without difficulty, made to bend its courſe downwards into the canal deſtined to receive it, and to circulate in the flues of the ovens; but, to my aſtoniſhment, I found that the ovens, inſtead of being heated, were barely warmed: an

accident

accident, however, very fortunately for me, diſcovered to me the real cauſe of the ill ſucceſs of the experiment.—Throwing a piece of paper on the top of the coals that were burning in the grate, in order to ſee if *the whole* of the large flame which I knew the paper muſt produce, would be drawn downwards into the horizontal opening of the canal, ſituated behind the back of the grate, I was ſurprized to find that this flame was not only drawn into this opening, but that it appeared to be violently *driven downwards*, to the very bottom of the canal.

In ſhort, every appearance indicated that there was a very ſtrong vertical *wind* that was continually blowing *directly downwards* into the opening of the canal: and it immediately occurred to me, that as this wind conſiſted of a ſtream of cold air, this air muſt neceſſarily cool the ovens almoſt as faſt as the flame heated them; and I was no longer ſurprized at the ill ſucceſs of my experiment.

On conſidering the ſubject with attention, I ſaw how impoſſible it muſt be for the current of hot vapour, flame, and ſmoke, that riſes from burning fuel, to be made to paſs off *horizontally*, or to deflect conſiderably from its direct aſcenſion, *in contact with the cold air of the atmoſphere*, without drawing after it a great deal of that cold air: and I now ſaw plainly why ſo much time and fuel were required to heat the boiler in the kitchen of the Foundling Hoſpital, in the experiments that were made with its firſt fire-place.

The cold air which entered the fire-place at its door, and paſſing *over* the ſurface of the burning fuel, entered the flues of the boiler with the flame, cooled the bottom of the boiler almoſt as faſt as the flame heated it.

The waſte of heat that is occaſioned *preciſely in this manner* in the fire-places of ſteam-engines, brewers coppers, diſtillers coppers, &c. muſt be very great indeed. To be convinced of this fact, nothing more is neceſſary than to ſee how very imperfectly the entrance into one of theſe fire-places is cloſed by its ſingle door, ill fitted to its frame—what a length of time the door is left *wide open* while the fire is ſtirring, or freſh coals are putting into the fire-place—and what an impetuous torrent of cold air ruſhes into the fire-place on thoſe occaſions.

As the cold air that comes into the fire-place in this manner, and paſſes *over* the burning coals, has very little to do in promoting the combuſtion of the fuel, and muſt neceſſarily be heated very hot in paſſing through the fire-place, and through the whole length of the flues of the boiler, it is eaſy to ſee what an immenſe quantity of heat this air muſt ſteal, and carry off into the atmoſphere in its eſcape up the chimney.

To remedy this evil, the doors of all cloſed fire-places ſhould be double, and they ſhould be fitted to their frames with the greateſt nicety, which may eaſily be done by making them ſhut againſt the front edge of their frames, inſtead of being fitted *into them*, or into grooves made to receive them; and when the fire is burning, theſe doors ſhould be opened as ſeldom as poſſible, and for as ſhort a time as poſſible. I have already mentioned the neceſſity of theſe precautions in my ſixth Eſſay, but they are of ſo much importance that they can hardly be too often recommended, nor can too much pains be taken to ſhew why they are ſo neceſſary.

In all caſes where a fire-place is very large, and where, in conſequence of the large quantity of coals conſumed in it, the fire-place door is neceſſarily kept open a great deal, I would earneſtly recommend the adoption of a contrivance, which I think could not fail to turn out a complete remedy for the evil we have been deſcribing—viz. the entrance of a torrent of cold air into the fire-place through its door-way.

The contrivance is this—to conſtruct the floor or pavement of the area before the fire-place door in ſuch a manner as to cut off all direct communication, without the fire-place, in front of it, between the aſh-pit and the fire-place door-way; and when this is done, to build a porch, well cloſed above, and on every ſide, immediately before the fire-place door, and in ſuch a manner that the fire-place door may open into it.

This porch muſt have a door belonging to it, ſituated on the ſide oppoſite to the fire-place door, which door (that belonging to the porch) muſt open outwards, and muſt fit its door-frame with conſiderable nicety. There muſt alſo be a glaſs window, either in this door, or over it, or on one ſide of it, or in one of the ſide walls of the porch;

and there muſt be ſufficient room in the porch to allow of a certain proviſion of coals being lodged there, and kept ready for uſe.

When freſh coals are to be thrown into the fire-place, (as alſo when the door of the fire-place is to be opened for the purpoſe of ſtirring the fire, or for any other purpoſe) the perſon who is charged with the care of the fire enters the porch, and then, carefully ſhutting the door of the porch after him, he opens the fire-place door.

As no air can get into the porch from without, its door being cloſed, none can paſs through it into the fire-place, and the fire-place door may be left open without the ſmalleſt inconvenience; and the perſon who tends the fire may take up as much time as he pleaſes in ſtirring it, or feeding it with freſh fuel, for little or no derangement of the fire, or loſs of heat, will reſult from theſe operations. The fire will continue to burn nearly in the ſame manner as it did before the fire-place door was opened; and thoſe immenſe clouds of denſe ſmoke, which, to the annoyance of the whole neighbourhood, are now thrown out of the chimnies of all great breweries, diſtilleries, ſteam-engines, &c. as often as they are fed with freſh coals, will no longer make their appearance.

When theſe operations are finiſhed, and the fire-place door is again cloſed, the door of the porch may be opened, and the proviſion of coals kept in the porch for immediate uſe may be again completed.

If the flame from the fire-place ſhould be found to have any tendency to come into the porch, this may be eaſily checked, by leaving a very ſmall hole in the door of the porch for the admiſſion of a ſmall quantity of air, juſt enough to prevent this accident. This ſmall hole might be furniſhed with a regiſter.

But it is not merely through the opening by which the fuel is introduced, that cold air furtively finds its way into cloſed fire-places: it frequently enters in much too large quantities by the aſh-pit door-way, and ruſhing up between the bars of the grate, and mixing with the flame, ſerves to diminiſh inſtead of increaſing the heat applied to the bottom of the boiler; and this never fails to happen when a *ſmall fire is made in a large fire-place*; or when a part of the grate happens not to be covered with burning fuel, eſpecially when there is no regiſter to the aſh-pit door.

It ſhould be remembered, that whenever more air enters a cloſed fire-place than is actually *decompoſed* by the burning fuel, all that ſuper-abundant air, not only is of no ſervice whatever, but being itſelf heated at the expence of the fire, and going off hot by the chimney, occaſions the loſs of a quantity of heat that might have been uſefully employed.

Aſh-pit doors ſhould always be furniſhed with regiſters, of whatever ſize the fire-place may be; for they are always indiſpenſably neceſſary to the good management of a fire;—and where ſmall fires are occaſionally made in large cloſed fire-places, the aſcent of air through that part of the grate that is not covered with burning fuel ſhould be prevented, by ſliding an iron-plate under the bars of the grate, or by ſome other contrivance equally effectual.

If the cloſed fire-places of boilers, great and ſmall, were properly conſtructed, and if due care were taken to introduce in a proper manner, and to regulate the quantity of the air that is neceſſary to the perfect combuſtion of the fuel, their grates might be made conſiderably narrower than they now are, and the bottoms of their boilers might be placed at a greater heighth above them; from which arrangement ſeveral advantages would be derived: but as long as ſo little care is taken to keep the door of the fire-place well cloſed, and to prevent too much air from coming up through the grate, by the openings between its bars, the bottom of the boiler muſt be placed very near the ſurface of the burning coals, otherwiſe ſo much more cold air than is wanted will find its way into the fire-place, and mix with the flame, that the bottom of the boiler cannot fail to be ſenſibly cooled by it.

When a boiler is properly ſet, if a fire, of a moderate ſize, that burns well, does not heat it in a reaſonable time, the fault muſt neceſſarily lie in the bad management of the doors and regiſters of the fire-place: for as the heat required to heat the boiler is *a certain quantity*, which cannot vary, if the boiler is not found to be heated as faſt as it ought to be, by the quantity of fuel conſumed, a part of the heat generated muſt neceſſarily go to heat ſomething elſe; and there is nothing at hand that can take it, except it be the cold air of the atmoſphere; which, whenever it is permitted to enter a fire-place in an improper manner, or in too large quantities, never fails to rob it of a great deal of heat, which it takes with it up the chimney, as has already been obſerved.

If the door by which the fuel is introduced into the cloſed fire-place of a kitchen boiler is not kept conſtantly cloſed, it is quite impoſſible that a well-conſtructed fire-place can anſwer.—With ſuch neglectful management *a bad fire-place* is certainly *preferable* to a good one; for when an enormous quantity of fuel is conſumed under a boiler, ſome part of it muſt neceſſarily find its way into it, even if, inſtead of being ſet in brick-work, it were ſuſpended over the fire, in the open air; but when a fire-place is made no larger than is neceſſary in order to heat the boiler in a proper time, when the door of the fire-place is kept cloſed, it is not ſurprizing that the boiler ſhould be much ſlower in acquiring heat, when a ſtream of cold air is permitted to ſtrike againſt its bottom, and blow all the flame and hot ſmoke out of its flues into the chimney.

It would be juſt as unreaſonable to object to the fire-places I have recommended on account of the *trouble of keeping them cloſed*, as it would be to object to a ſcheme for warming a dwelling-houſe merely becauſe it required that the ſtreet-door ſhould not be left open.—The caſes are exactly ſimilar; and if inſiſting on the attention of ſervants in the one caſe is not unreaſonable; it cannot be ſo in the other.

There was a time, no doubt, (when the doors of rooms firſt came in faſhion) that the trouble they occaſioned to ſervants was conſidered as an hardſhip, and ſeverity in exacting attention to the proper management of them as a grievance; but all improvements are progreſſive, and we may hope that a time will come when it will be conſidered as careleſs and ſlovenly to leave open the door of a cloſed fire-place. In the mean time it is my duty to declare, in the *moſt ſerious and public manner*, that thoſe who have not influence enough with their ſervants to ſecure due attention being paid to this important point, would do wiſely not to attempt to introduce the improvements in cloſed fire-places which I have recommended. And it is not ſufficient merely to be attentive to the ſhutting of the fire-place door; care muſt be taken alſo to manage properly the regiſter of the aſh-pit door, otherwiſe, if it be left too much opened, a great deal too much cold air will find its way into the fire-place between the bars of the grate.

When a cloſed fire-place is properly conſtructed, it is hardly to be believed how ſmall a paſſage is ſufficient to admit as much air as is neceſſary or uſeful to maintain the combuſtion of the fuel.

A fault, which is often committed in the management of the cloſed fire-places I have recommended, is the *over-loading them with fuel.* This miſtake has ſeveral bad conſequences, and among them there is one which would not naturally be expected; it prolongs the kindling of the fire, and very frequently ſo much ſo as to prolong the heating of the boiler, notwithſtanding the fierceneſs of the fire when the fuel is all inflamed.

Great care ſhould at all times be taken not to overcharge a fire-place with fuel, but more eſpecially when the fire is firſt kindled, and the fire-place, and every thing about it, is cold. It ſhould be remembered that a great deal of heat is neceſſary to warm the fuel itſelf, and bring it to that degree of heat which it muſt have in order to its being capable of taking fire; and as long as there remains any cold fuel in the fire-place to be heated, very little heat will reach the bottom of the boiler.

All the money that is expended in the purchaſe of wood to kindle coal fires, is money well laid out; and it is by no means good economy to be ſparing of wood in kindling ſuch fires. In many caſes it would, I am convinced, be cheaper to burn wood than coals, even in London, eſpecially in the cloſed fire-places of ſmall kitchen boilers and ſtewpans, where a fire is wanted but for a ſhort time. This propoſal to burn wood inſtead of coals, or charcoal, has already been made more than once; and the more I have conſidered the ſubject, the more I am convinced that the former would turn out to be the cheapeſt fuel.

A great deal of fuel is conſumed in this country for boiling water to make tea. I was curious to know how low it would be poſſible to reduce that expence, and aſcertained that point by the following experiments and computations:

I ſuppoſed a ſmall family, conſiſting of two perſons, to drink tea twice every day (morning and evening) during one whole year, and that 2 pints of water, at the temparature of 55° (the mean annual temperature of the atmoſphere in Great Britain) was heated, and made to boil every time tea was made.

I found on enquiry that the moſt coſtly firewood that is ſold in London, dry beech in billets, at the higheſt price it is ever ſold at, coſt one farthing per lb. avoirdupois weight; that is, at the rate of *two-pence* per billet, weighing, at an average 8 lbs. By wholeſale theſe billets are ſold in London at *one-penny-half-penny* each.

I had ſome of theſe billets ſawed into lengths of about 5 inches, and then ſplit into ſmall pieces (about the ſize of the end of one's little finger) and bound up with a packthread into little ſmall bundles, weighing about 4 or 5 ounces each. In the middle of each bundle there were a few ſmaller ſplinters, and a very ſmall piece of paper, that the bundle might eaſily be ſet on fire with a candle, or with a common match.

On uſing the ſmall portable furnace repreſented in the figure 63, and deſcribed in chap. XI. of the Tenth Eſſay, page 293, and the ſmall tin tea-kettles repreſented in the figure 68, in that Eſſay, I found, by an experiment, which was repeated ſeveral times, that I could boil 2 pints of water with a bundle of wood, weighing 4 ounces.

Hence it appears that the daily conſumption of wood in boiling water for tea for two perſons would be 8 ounces, or half a pound weight; conſequently for one year, or 365 days, 182 ½ lbs. would be required; and that quantity, at 1 farthing the pound, would coſt 182 ½ farthings = 45 ⅝ pence, or *three ſhillings* and *nine-pence-halfpenny* and *half a farthing*.

Were it poſſible to heat ſo ſmall a quantity of water, with the conſumption of the ſame proportion of fire-wood, as was found to be ſufficient for heating water in ſome of the experiments, of which an account is given in the Sixth Eſſay, the annual expence for fire-wood for boiling water for making tea for two perſons twice a day, would amount to no more than 57 lbs. weight, which, at the London price of this wood, one farthing in the pound, would coſt 57 farthings, or *one ſhilling and two-pence-farthing*.

It is by computations of this ſort, founded on the reſults of unexceptionable experiments, that we are enabled to appreciate the vaſt ſaving to individuals, and to the public, that would reſult from proper attention being paid to the management of fire, and to the economy of heat.

END OF THE FOURTEENTH ESSAY.

ESSAY XV.

OF THE USE OF STEAM,

AS A

VEHICLE FOR TRANSPORTING HEAT

FROM

ONE PLACE TO ANOTHER.

CONTENTS OF THIS ESSAY.

Many unſucceſsful attempts have been made, at different times, to heat liquids by means of ſteam—Reaſon why theſe attempts failed—When ſteam is uſed for heating a liquid, it muſt be introduced into it far below its ſurface, otherwiſe, as heat does not deſcend in fluids, the liquid cannot be uniformly heated—Detailed account of an apparatus, by means of which liquid may be heated, and made to boil, by ſteam coming from a boiler at a diſtance, and introduced into them—This plan has been adopted with the moſt complete ſucceſs—Deſcription of the DYING-HOUSE *of Meſſrs. Gott and Co. at Leeds, in which all the Coppers are heated by ſteam—Deſcription of the* CULINARY STEAM APPARATUS *in the kitchen at the houſe of the Royal Inſtitution—Propoſals for employing hot, or ſtrong ſteam, in* ALLUM WORKS, *and in* DISTILLERIES—*Of the uſe that may be made of ſteam in* DRYING-HOUSES.

ESSAY XV.

Of the Uſe of Steam, as a Vehicle for tranſporting Heat.

Many attempts have been made, at different periods, to heat liquids by means of ſteam introduced into them; but moſt of theſe have failed: and, indeed, until it was known that fluids are non-conductors of heat, and, conſequently, that heat cannot be made to *deſcend* in them—(which is a recent diſcovery)—theſe attempts could hardly ſucceed; for, in order to their being ſucceſsful, it is abſolutely neceſſary that the tube, which conveys the hot ſteam, ſhould open into the *loweſt part* of the veſſel which contains the liquid to be heated, or nearly on a level with its bottom; but as long as the erroneous opinion obtained, that heat could paſs in fluids *in all directions*, there did not appear to be any reaſon for placing the opening of the ſteam tube *at the bottom of the veſſel*, while many were at hand which pointed out other places as being more convenient for it.

But to ſucceed in heating liquids by ſteam, it is neceſſary, not only that the ſteam ſhould enter the liquid at the bottom of the veſſel which contains it, but alſo that it ſhould enter it *coming from above*.

The ſteam-tube ſhould be in a vertical poſition, and the ſteam ſhould *deſcend* through it, previous to its entering the veſſel, and mixing with the liquid which it is to heat; otherwiſe this liquid will be in danger of being forced back by this opening into the ſteam-boiler; for as the hot ſteam is ſuddenly condenſed on coming into contact with the cold liquid, a vacuum is neceſſarily formed in the end of the tube; into which vacuum the liquid in the veſſel—preſſed by the whole weight of the incumbent atmoſphere—will ruſh with great force, and with a loud noiſe; but if this tube be placed in a vertical poſition, and if it be made to riſe to the height of ſix or ſeven feet above the level of the ſurface of the liquid which is to be heated, the portion of the liquid, which is thus forced into the lower end of the tube, will not have time to riſe to that height before it will be met by ſteam, and obliged to return back into the veſſel.

There will be no difficulty in arranging the apparatus in ſuch a manner, as effectually to prevent the liquid to be heated from being forced backwards into the ſteam boiler; and, when this is done, and ſome other neceſſary precautions to prevent accidents are taken, ſteam may be employed, with great advantage, for heating liquids; and for keeping them hot, in a variety of caſes, in which fire, applied immediately to the bottoms of the containing veſſels, is now uſed.

In dying, for inſtance, in bleaching, and in brewing, and in the proceſſes of many other arts and manufactures, the adoption of this method of applying heat would be attended, not only with a great ſaving of labour, and of fuel, but alſo of a conſiderable ſaving of expence in the purchaſe and repairs of boilers, and of other expenſive machinery: for, when ſteam is uſed inſtead of fire, for heating their contents, boilers may be made extremely thin and light; and, as they may eaſily be ſupported and ſtrengthened by hoops and braces of iron, and other cheap materials, they will coſt but little, and ſeldom ſtand in need of repairs.

To theſe advantages we may add others of ſtill greater importance: Boilers intended to be heated in this manner may, without the ſmalleſt difficulty, be placed in any part of a room—at any diſtance from the fire;—and in ſituations in which they may be approached freely on every ſide. They may moreover eaſily be ſo ſurrounded with wood, or with other cheap ſubſtances, which form warm covering, as moſt completely to confine the heat within them, and prevent its eſcape. The tubes by which the ſteam is brought from the principal boiler (which tubes may conveniently be ſuſpended juſt below the ceiling of the room) may, in like manner, be covered, ſo as almoſt entirely to prevent all loſs of heat by the ſurfaces of them; and this, to whatever diſtances they may be made to extend.

In ſupending theſe ſteam-tubes, care muſt, however, be taken, to lay them in a ſituation, *not perfectly*

fectly horizontal, under the ceiling, but to incline them at a ſmall angle, making them riſe gradually from their junction with the top of a large vertical ſteam-tube, which connects them with the ſteam, boiler, quite to their fartheſt extremities: for, when theſe tubes are ſo placed, it is evident that all the water formed in them, in conſequence of the condenſation of the ſteam in its paſſage through them, will run backwards, and fall into the boiler, inſtead of accumulating in them, and obſtructing the paſſage of the ſteam, (which it would not fail to do were there any conſiderable bends or wavings, upwards and downwards, in theſe tubes) or, of running forward, and deſcending with the ſteam into the veſſels containing the liquids to be heated;—which would happen if theſe tubes inclined *downwards*, inſtead of inclining upwards, as they recede from the boiler.

In order that clear and diſtinct ideas may be formed of the various parts of this apparatus,—even without figures,—I ſhall diſtinguiſh each part of it by a ſpecific name: The veſſel in which water is boiled in order to generate ſteam—and which, in its conſtruction, may be made to reſemble the boiler of a ſteam engine—I ſhall call the *ſteam-boiler*:—The vertical tube, which, riſing up from the top of the boiler, conveys the ſteam into the tubes (nearly horizontal), which are ſuſpended from the cieling of the room, I ſhall call the *ſteam reſervoir*:—To the horizontal tubes I ſhall give the name of *conductors of ſteam*:—and to the (ſmaller) tubes, which, deſcending perpendicularly from theſe *horizontal conductors*, convey the ſteam to the liquids which are to be heated, I ſhall, excluſively, appropriate the appellation of *ſteam-tubes.*

The veſſels in which the liquids that are to be heated are put, I ſhall call the *containing veſſels.*—Theſe veſſels may be made of any form; and, in many caſes, they may, without any inconvenience, be conſtructed of wood, or of other cheap materials, inſtead of being made of coſtly metals, by which means a very heavy expence may be avoided: or they may be merely pits ſunk in the ground, and lined with ſtone, or with bricks.

Each *ſteam-tube* muſt deſcend *perpendicularly* from the *horizontal conductor* with which it is connected, to the level of the bottom of the *containing veſſel* to which it belongs; and, moreover, muſt be furniſhed with a good cock, perfectly ſteam-tight; which may beſt be placed at the height of about ſix feet above the level of the floor of the room.

This *ſteam-tube* may either deſcend *within the veſſel* to which it belongs, or *on the outſide of it*, as ſhall be found moſt convenient. If it comes down on the outſide of the veſſel, it muſt enter it at its bottom, by a ſhort horizontal bend: and its junction with the bottom of the veſſel muſt be well ſecured, to prevent leakage. If it comes down into the veſſel, on the inſide of it, it muſt deſcend to the bottom of it, or at leaſt to within a very few inches of the bottom of it; otherwiſe the liquid in the veſſel will not be uniformly, or equally heated.

When the ſteam-tube is brought down on the inſide of the containing veſſel, it may either come down perpendicularly, and without touching the ſides of it, or it may come down on one ſide of the veſſel, and in contact with it.

When ſeveral ſteam-tubes, belonging to different containing veſſels, are connected with one and the ſame horizontal ſteam conductor, the upper end of each of theſe tubes, inſtead of being ſimply attached by ſolder or by rivets to the under ſide of the conductor, muſt *enter*, at leaſt one inch, *within the cavity of it*; otherwiſe the water reſulting from a condenſation of a part of the ſteam in the conductor, by the cold air which ſurrounds it, inſtead of finding its way back into the ſteam-boiler, will deſcend through the ſteam-tubes, and mix with the liquids in the veſſels below; but when the open ends of theſe tubes *project upwards within the ſteam conductor*, though it be but to a ſmall height above the level of its under ſide, it is evident that this accident cannot happen.

It is not neceſſary to obſerve here, that, in order that the ends of the ſteam-tubes may project *within* the *horizontal conductor*, the diameters of the former muſt be conſiderably leſs than the diameter of the latter.

To prevent the loſs of heat ariſing from the cooling of the different tubes through which the ſteam muſt paſs in coming from the boiler, all thoſe tubes ſhould be well defended from the cold air of the atmoſphere, by means of warm covering; but this may eaſily be done, and at a very trifling expence. The horizontal conductors may be encloſed within ſquare wooden tubes, and ſurrounded on every ſide by charcoal duſt,—fine ſawduſt,—or even by wool;—and the ſteam tubes, as well as the reſervoir of ſteam, may be ſurrounded, firſt by three or four coatings of ſtrong paper, firmly attached to them by paſte, or glue, and covered with a coating of varniſh; and then by a covering of thick coarſe cloth. It will likewiſe be adviſable to cover the horizontal conductors with ſeveral coatings of paper; for if the paper be put on to them while it is wet with the paſte or glue, and if care be taken to put it on in long ſlips, or bands, wound regularly round the tube in a ſpiral line, from one end of it to the other, this covering will be uſeful, not only by confining more effectually the heat, but alſo, by adding very much to the ſtrength of the tube, and rendering it unneceſſary to employ thick and ſtrong ſheets of metal in the conſtruction of it.

However extraordinary and incredible it may appear, I can aſſert it as a fact, which I have proved by repeated experiments, that if a hollow tube, conſtructed of ſheet copper $\frac{1}{20}$ of an inch in thickneſs, be covered by a coating only twice as thick, or $\frac{1}{10}$ of an inch in thickneſs, formed of layers of ſtrong paper, firmly attached to it by good glue,

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the ſtrength of the tube will be ***more than doubled*** by this covering.

I found by experiments, the moſt unexceptionable and deciſive—of which I intend at ſome future period to give to the public a full and detailed account,—that the ſtrength of paper is ſuch, when ſeveral ſheets of it are firmly attached together with glue, that a ſolid cylinder of this ſubſtance, the tranſverſe ſection of which ſhould amount to only one ſuperficial inch, would ſuſtain a weight of 30,000 lbs. avoirdupois, or above 13 tons, ſuſpended to it, without being pulled aſunder or broken.

The ſtrength of hemp is ſtill much greater, when it is pulled equally, in the direction of the length of its fibres. I found, from the reſults of my experiments with this ſubſtance, that a cylinder of the ſize above mentioned, compoſed of the ſtraight fibres of hemp, glued together, would ſuſtain 92,000 lbs. without being pulled aſunder.

A cylinder, of equal dimenſions, compoſed of the ſtrongeſt iron I could ever meet with, would not ſuſtain more than 66,000 lbs. weight; and the iron muſt be very good not to be pulled aſunder with a weight equal to 55,000 lbs. avoirdupois.

I ſhall not, in this place, enlarge on the many advantages that may be derived from a knowledge of theſe curious facts. I have mentioned them now, in order that they may be known to the public; and that ingenious men, who have leiſure for theſe reſearches, may be induced to turn their attention to a ſubject, not only very intereſting, on many accounts, but which promiſes to lead to moſt important improvements in mechanics.

I cannot return from this digreſſion without juſt mentioning one or two reſults of my experimental inveſtigations relative to the force of coheſion, or ſtrength of bodies, which, certainly, are well calculated to excite the curioſity of men of ſcience.

The ſtrength of bodies of different ſizes, *ſimilar in form*, and compoſed of the *ſame ſubſtance*,—or the forces by which they reſiſt being pulled aſunder by weight ſuſpended to them, and acting in the direction of their lengths—*are not in the ſimple ratio of the areas of their tranſverſe ſections*, or of their *fractures* ;—but in a higher ratio—and this ratio is different in different ſubſtances.

The *form* of a body has a conſiderable influence on its ſtrength, *even when it is pulled in the direction of its length.*

All bodies, even the moſt brittle, appear to be *torn aſunder*, or their particles ſeparated, or fibres broken, *one after the other* ; and hence it is evident, that that *form* muſt be moſt favourable to the ſtrength of any given body, pulled in the direction of its length, which enables the greateſt number of its particles, or longitudinal fibres, to be ſeparated to the greateſt poſſible diſtance—ſhort of that at which the force of coheſion is overcome,—before *any of them* have been forced *beyond* that limit.

It is more than probable that the apparent ſtrength of different ſubſtances depends much more on the number of their particles that come into action before any of them are forced beyond the limits of the attraction of coheſion, than on any ſpecific difference in the intenſity of that force in thoſe ſubſtances.

But to return to the ſubject more immediately under conſideration.—As it is eſſential that the ſteam employed in heating liquids, in the manner before deſcribed, ſhould enter the containing veſſel at, or very near, its bottom, it is evident that this ſteam muſt be ſufficiently ſtrong, or elaſtic, to overcome, not only the preſſure of the atmoſphere, but alſo the additional preſſure of the ſuperincumbent liquid in the veſſel; the ſteam boiler muſt, therefore, be made ſtrong enough to confine the ſteam, when its elaſticity is ſo much increaſed by means of additional heat, as to enable it to overcome that reſiſtance. This increaſe of the elaſtic force of the ſteam need not, however, in any caſe, exceed a preſſure of five or ſix pounds upon a ſquare inch of the boiler, or *one third part*, or *one half*, of an atmoſphere.

It is not neceſſary for me to obſerve here, that in this, and alſo in all other caſes, where ſteam is uſed as a vehicle for conveying heat from one place to another, it is indiſpenſably neceſſary to provide *ſafety-valves* of two kinds;—the one for letting a part of the ſteam eſcape, when, on the fire being ſuddenly increaſed, the ſteam becomes ſo ſtrong as to expoſe the boiler to the danger of being burſt by it *;—the other for admitting air into the boiler, when, in conſequence of the diminution of the heat, the ſteam in the boiler is condenſed, and a vacuum is formed in it; and when, without this valve, there would be danger, either of the ſides of the boiler being cruſhed, and forced inwards by the preſſure of the atmoſphere from without; or of the liquid in the containing veſſels being forced upwards into the horizontal ſteam-conductors, and from thence into the ſteam-boiler. The laſt-mentioned accident, however, cannot happen, unleſs the cocks in ſome of the ſteam tubes are left open.—The two valves effectually prevent all accidents.

The reader will, no doubt, be more diſpoſed to pay attention to what has here been advanced on this intereſting ſubject, when he is informed that the propoſed ſcheme has already been executed on a very large ſcale, and with complete ſucceſs; and that the above details are little more than exact deſcriptions of what actually exiſts.

A great mercantile and manufacturing houſe at Leeds, that of Meſſrs. Gott, and Co. had the courage, notwithſtanding the mortifying prediction of all their neighbours, and the ridicule with

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* The ſteam which eſcapes out of the boiler through the ſafety-valve may very eaſily be made to paſs into the reſervoir of water which feeds the boiler, and be condenſed there; which will warm that water, and by that means ſave a quantity of heat, which otherwiſe would eſcape into the atmoſphere, and be loſt.

which the ſcheme was attempted to be treated, to erect a *dying-houſe*, on a very large ſcale indeed, on the principles here deſcribed and recommended.

On my viſit to Leeds in the ſummer of the year 1800, I waited on Mr. Gott, who was then mayor of the town, and who received me with great politeneſs, and ſhowed me the cloth-halls, and other curioſities of the place: but nothing he ſhowed me intereſted me half ſo much as his own truly noble manufactory of ſuperfine woollen cloths.

I had ſeen few manufactories ſo extenſive, and none ſo complete in all its parts. It was burnt to the ground the year before, and had juſt been rebuilt, on a larger ſcale; and with great improvements in almoſt every one of its details.

The reader may eaſily conceive that I felt no ſmall degree of ſatisfaction, on going into the dying-houſe, to find it fitted up on principles which I had ſome ſhare in bringing into repute, and which Mr. Gott told me he had adopted in conſequence of the information he had acquired in the peruſal of my *Seventh* Eſſay.

He aſſured me that the experiment had anſwered, even far beyond his moſt ſanguine expectations; and, as a ſtrong proof of the utility of the plan, he informed me, that his next door neighbour, who is a dyer by profeſſion, and who, at firſt, was ſtrongly prejudiced againſt theſe innovations, had adopted them, and is now convinced that they are real improvements.

Mr. Gott aſſured me, that he had no doubt but they would be adopted by every dyer in Great Britain in the courſe of a very few years.

The dying-houſe of Meſſrs. Gott and Co. which is ſituated on the ground floor of the principal building of the manufactory, is very ſpacious, and contains a great number of coppers, of different ſizes; and as theſe veſſels, ſome of which are very large, are diſtributed about promiſcuouſly, and apparently without any order in their arrangement, in two ſpacious rooms,—each copper appearing to be inſulated, and to have no connection whatever with the others,—all of them together form a very ſingular appearance.

The rooms are paved with flat ſtones, and the the brims of all the coppers—great and ſmall—are placed at the ſame height (about three feet) above the pavement. Some of theſe coppers contain upwards of 1800 gallons; and they are all heated by ſteam from *one ſteam-boiler*, which is ſituated in a corner of one of the rooms, almoſt out of ſight.

The horizontal tubes, which ſerve to conduct the ſteam from the boiler to the coppers, are ſuſpended juſt below the ceiling of the rooms: they are made—ſome of lead—and ſome of caſt-iron; and are from four to five inches in diameter; but when I ſaw them, they were naked, or without any covering to confine the heat. On my obſerving to Mr. Gott that coverings for them would be uſeful, he told me that it was intended that they ſhould be covered, and that coverings would be provided for them.

The vertical *ſteam-tubes*, by which the ſteam paſſes down from the horizontal *ſteam-conductors* into the coppers, are all conſtructed of lead; and are from $\frac{3}{4}$ of an inch to $2\frac{1}{2}$ inches in diameter; being made larger or ſmaller according to the ſizes of the coppers to which they belong. Theſe ſteam-tubes all paſs down on the *outſides* of their coppers, and enter them horizontal at the level of their bottoms. Each copper is furniſhed with a braſs cock, for letting off its contents; and it is filled with water from a ciſtern at a diſtance, which is brought to it by a leaden pipe. The coppers are all ſurrounded by thin circular brick-walls, which ſerve not only to ſupport the coppers, but alſo to confine the heat.

The rapidity with which theſe coppers are heated, by means of ſteam, is truly aſtoniſhing. Mr. Gott aſſured me, that one of the largeſt of them, containing upwards 1800 gallons, when filled with cold water from the ciſtern, requires no more than *half an hour* to heat it till it actually boils!—By the greateſt fire that could be made under ſuch a copper, it would hardly be poſſible make it boil in leſs than an hour.

It is eaſy to perceive that the *ſaving of time*, which will reſult from the adoption of this new mode of applying heat, will be very great;—and it is likewiſe evident that it may be increaſed, almoſt without limitation, merely by augmenting the diameter of the ſteam-tube: Care muſt, however, be taken, that the boiler be ſufficiently large to furniſh the quantities of ſteam required.—The *ſaving of fuel* will alſo be very conſiderable: Mr. Gott informed me, that, from the beſt calculation he had been able to make, it would amount to near two-thirds of the quantity formerly expended, when each copper was heated by a ſeparate fire.

But theſe ſavings are far from being the only advantages that will be derived from the introduction of theſe improvements in the management of heat: There is one, of great importance indeed—not yet mentioned—which alone would be ſufficient to recommend the very general adoption of them.—As the heat communicated by ſteam can never exceed the mean temperature of boiling water by more than a very few degrees, the ſubſtances expoſed to it can never be injured by it.

In many arts and manufactures this circumſtance will be productive of great advantages, but in none will its utility be more *apparent* than in cookery; and eſpecially in public kitchens,—where great quantities of food are prepared in large boilers;—for, when the heat is conveyed in this manner, all the labour now employed in ſtirring about the contents of thoſe boilers, to prevent the victuals from being ſpoiled by burning to the bottoms of them, will be unneceſſary; and the loſs of heat occaſioned by this ſtirring, prevented;—and, inſtead of expenſive coppers, or metallic boilers, which are ſometimes unwholeſome, and always difficult to be kept clean, and often ſtand in need of repairs,—common wooden tubs may, with great advantage, be uſed as culinary veſſels; and their contents may be heated by *portable fire-places*, by means of ſteam-boilers attached to them.

As theſe portable fireplaces and their ſteam, boilers may, without the ſmalleſt inconvenience, be made of ſuch weight, form, and dimenſions, as to be eaſily tranſported from one place to another, by two men; and be carried through a door-way of the common width;—with this machinery, and the ſteam-tubes belonging to it, and a few wooden tubs, a complete public kitchen, for ſupplying the poor, and others, with ſoups, and alſo with puddings, vegetables, meat, and all other kinds of food prepared by *boiling*, might be eſtabliſhed in half an hour, in any room, in which there is a chimney (by which the ſmoke from the portable fire-place can be carried off); and, when the room ſhould be no longer wanted as a kitchen, it might, in a few minutes, be cleared of all this culinary apparatus, and made ready to be uſed for any other purpoſe.

This method of conveying heat is peculiarly well adapted for heating baths: It is likewiſe highly probable that it would be found uſeful in the bleaching buſineſs, and in waſhing linen. It would alſo be very uſeful in all caſes where it is required to keep any liquid at about the boiling point for a long time without making it boil; for the quantity of heat admitted may be very nicely regulated by means of the braſs cock belonging to the ſteam-tube. Mr. Gott ſhowed me a boiler in which ſhreds of ſkins were digeſting in order to make glue, which was heated in this manner; and in which the heat was ſo regulated, that, although the liquid never actually boiled, it always appeared to be upon the very point of beginning to boil.

This temperature had been found to be beſt calculated for making good glue. Had any other *lower* temperature been found to anſwer better, it might have been kept up with the ſame eaſe, and with equal preciſion, by regulating properly the quantity of ſteam admitted.

I need not ſay how much this country is obliged to Mr. Gott, and his worthy colleagues.—To the ſpirited exertions of ſuch men—who abound in no other country—we owe one of the proudeſt diſtinctions of our national character;—that of being *an enlightened and an enterprizing people.*

In fitting up the great kitchen at the houſe of the Royal Inſtitution, I availed myſelf of that opportunity to ſhow, in a variety of different ways, how ſteam may be uſefully employed in heating liquids.

On one ſide of the room, oppoſite to the fire-place, and where there is no appearance of any chimney, I fitted up a ſteam-boiler, of caſt-iron, which, to confine the heat, is ſo compleatly covered up by the brick-work in which it is ſet, that no part of it is ſeen. This boiler is ſupplied with water from a reſervoir at a diſtance (which is not ſeen) and by means of a cock, which is regulated by an hollow floating ball of thin copper, the water in the boiler always ſtands at the ſame height, or level.

The ſteam from this boiler riſes up perpendicularly in a tin tube, which is concealed in a ſquare wooden tube, by the ſide of the wall of the room, and enters an horizontal tin tube (concealed in the ſame manner) which lies againſt the wall, and juſt under the ceiling.

From this horizontal ſteam *conductor* three tubes deſcend, perpendicularly (concealed in three ſquare wooden tubes) and enter three different kitchen boilers (on a level with their bottoms) which are ſet in brick work, againſt the ſame ſide of the room where the ſteam boiler is ſituated.

As each of theſe boilers has its ſeparate fire-place, properly furniſhed with a good double door, and regiſter aſh-pit door; and alſo with a canal, furniſhed with a damper, for carrying off the ſmoke; either of theſe three boilers may be uſed for cooking, either with a fire made under it, or with ſteam brought into it, from the neighbouring ſteam-boiler.

The object I had principally in view in this arrangement was to ſhew, in the moſt ſtriking and convincing manner, that all the different proceſſes of cookery, which are performed by boiling, ſuch as boiling meat and vegetables *in boiling water*—making ſoups—ſtewing, &c. may, in all caſes, be performed quite as well, and in many much better, by heating the liquid which is to be boiled, and keeping it boiling, by admitting hot ſteam *into it*, than by making a fire *under it*.

By uſing one of theſe boilers *alternately* in theſe two ways, on different days, in preparing the ſame kind of food, I concluded that all doubts on this ſubject would be moſt effectually removed.

To exhibit in a manner ſtill more ſtriking the application of ſteam to the boiling of liquids for culinary purpoſes, the following arrangement has been made, and completed.—An horizontal ſteam-conductor (concealed in a ſquare wooden tube) communicating, at right angles, with the ſteam conductor before deſcribed, paſſes, juſt below the ceiling, from the middle of one ſide of the room, to the middle of the ceiling; and ends in a veſſel, in the form of a flat drum, about ten inches in diameter, and five inches high, which is attached to the ceiling, perpendicularly over the center of a large table, which is placed in the middle of the room.

On the outſide of this drum, or ſhort hollow cylinder (which is made of tin, and covered with wood, to confine the heat) there are, at equal diſtances, four projecting horizontal tubes, each about one inch in diameter, and two inches long, which communicate with the inſide of the drum. Theſe tubes all point to the ſame center, namely, to the center of the drum.

To each of theſe ſhort horizontal tubes, there is fixed one end of a ſteam tube compoſed of three pieces, fixed to each other, and moveáble, by means of joints, which are all ſteam-tight.

The end of this compound flexible ſteam-tube is united to the end of the ſhort tube, which projects from the ſide of the drum, by means of a ſteam-joint, in ſuch a manner, that the ſteam-tube, attached to the drum, and communicating with it, may either be folded up, in joints, or lengths, juſt under the ceiling, or it may be made to hang down from the end of the ſhort tube to which it is attached.—The lower joint, or rather diviſion of this flexible ſteam-tube, which reaches nearly to the top of the table, is furniſhed with a braſs cock, by which it is occaſionally cloſed; or rather, by which it is always kept cloſed when it is not in actual uſe.

I might perhaps ſpare myſelf the trouble of deſcribing the manner in which this culinary ſteam apparatus is uſed, as the imagination of the reader will moſt probably have run before me. I ſhall, however, juſt mention a very ſtriking and pleaſing manner of making the experiment, in which the action of this machinery will be exhibited to great advantage.

If the cold water, which is to be heated, and made to boil by the ſteam, is put into a large glaſs bowl, or jar; on plunging the lower end of one of the flexible ſteam-tubes into the water, and then opening the ſteam-cock, the agitation into which the water in the glaſs veſſel will be thrown will be viſible through the glaſs; and the paſſage of the ſteam, in its elaſtic form, upwards, through the water into the air, *after the water has become boiling hot*, and not before, will be an inſtructive, as well as an amuſing experiment.

Thoſe of the flexible ſteam-tubes which are not in actual uſe, are kept ſo folded up, (in order to their being out of the way) that their two upper diviſions, lying by the ſide of each other, in an horizontal poſition, are juſt under the ceiling of the room; while their lower diviſions hang vertically downwards, pointing towards the table.

In order that the kitchen may not be filled with ſteam when any of the boilers on the ſide of the room are uſed, their covers are all furniſhed with ſteam-tubes, which, communicating by a particular contrivance, with an horizontal ſteam-tube, which lies immediately over theſe boilers juſt under the ceiling, and which, by paſſing through the wall of the building, opens into the external air, all the waſte ſteam from theſe boilers is carried out of the kitchen.

Before I conclude this Eſſay, I ſhall add a few obſervations concerning an application of ſteam, which has not yet, to my knowledge, been made, but which there is much reaſon to think would turn out to be of very great importance indeed in many caſes.—This is the employing of it for communicating *degrees of heat above that of boiling water.*

I was led to meditate on this ſubject by an account I received, not long ago, of ſome very ſurprizing effects which were produced in bleaching, by uſing the ſteam of a very ſtrong ſolution of pot-aſh for boiling the linen, inſtead of water; as I was confident that no part of the alkali could poſſibly be evaporated in this proceſs, I could not account in any other way for the effects produced, but by ſuppoſing them to have been owing to the *high temperature* of the ſteam which roſe from this ſtrong lixivium: and, as ſteam, at a high temperature, might eaſily be procured, and applied to the linen, without the uſe of the alkali, I thought it would be worth while to try the experiment with hot ſteam, produced from pure water. I mentioned this idea to Mr. Duffin, ſecretary of the Linen Board in Ireland, who is himſelf concerned, in an extenſive way, in the bleaching buſineſs, who has promiſed to make ſome experiments on this ſubject, which I took the liberty to point out, and to recommend to him, as being likely to lead to intereſting reſults.

Meditating on the various uſes to which *hot*, or (which is the ſame thing) *ſtrong ſteam* might be applied, it occurred to me that it would probably be found to be extremely uſeful in *allum works*, for concentrating the liquor from which allum is cryſtalized. There are, as is well known, many difficulties attending the evaporation and concentration of that liquid; and it is never done without occaſioning a very conſiderable expence, as well for fuel, of which large quantities are conſumed, as alſo on account of the frequent repairs of the pans, which are found to be neceſſary.

Moſt, if not all theſe difficulties, might, I think, be avoided, by introducing ſtrong ſteam into this liquor, inſtead of concentrating it over a fire. This concentration might certainly be effected as well, and probably better, and more expeditiouſly, by uſing hot ſteam, than by the immediate uſe of the heat of a fire; and the expence occaſioned by the wear and tear of the apparatus would, no doubt, be much leſs in the former caſe than in the latter: and, if it ſhould be found (which is not unlikely) that *ſome certain temperature* is more advantageous in this proceſs than any other, *that temperature*, when once diſcovered, may be preſerved, with very little variation, when ſteam is uſed (by placing a valve, loaded with a proper weight, in the ſteam-tube, and obliging the ſteam to lift that valve, in order to paſs through the tube); but there is no poſſibility of regulating, with any preciſion, the degrees of heat employed, when liquids are evaporated in boilers over a fire.

I would juſt point out one more application of ſteam, which, if I am not much miſtaken, will turn out to be very advantageous indeed, in many reſpects;—it may be employed in heating the fermented liquor from which ardent ſpirits are diſtilled.

A propoſal for introducing watery vapour into a liquor from which pure ardent ſpirits are to be diſtilled, or forced away by heat, will, no doubt, be thought very extraordinary by thoſe who have never meditated on the ſubject; but when they ſhall have conſidered it with attention, they will find reaſon to conclude that this method of diſtilling bids fair to be very uſeful. The ſaving of expence for coppers, and other coſtly utenſils and machinery, would be very conſiderable; and the danger of the flavour of the ſpirits being injured by the burning of the liquor to the ſides of the copper, would be entirely removed.

Steam has already been introduced, in ſeveral great manufactories in this country, into *drying-houſes*, and employed, with the beſt effects, for heating and drying linen, cotton, and woollen goods, after they have been waſhed:—it has alſo been uſed in the *drying-rooms* of ſeveral paper manufactories. When it is uſed for any of theſe purpoſes, it ſhould be introduced into tubes of large diameter, or into ſeveral ſmaller tubes, conſtructed of very thin ſheet copper (or into any other metallic tubes, *having a large ſurface*, that would be cheaper) and theſe tubes ſhould be placed nearly in an horizontal poſition in the *lower part* of the drying-room, and *under* the goods that are to be dried; and, (in order to economize the heat as much as poſſible) the water reſulting from the condenſation of the ſteam in the ſteam-tubes, ſhould be conducted, by ſmall tubes, well covered with warm covering, into the reſervoir which feeds the ſteam-boiler.

END OF THE FIFTEENTH ESSAY,

AND OF THE

THIRD VOLUME.